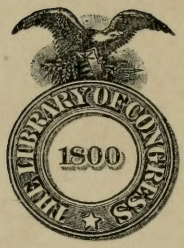
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MANUAL

OF

OPERATIVE VETERINARY SURGERY,

BY

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TO

DR. A. CHAUVEAU,

Member of the Institute (Paris), General Inspector of the Veterinary Schools (France), Professor to the Museum of Natural History (Paris),

As a humble token of the high appreciation of his scientific labors in behalf of Veterinary and Comparative Medicine, this work is, with kind permission, dedicated by

THE AUTHOR.

PREFACE.

If an apology should be deemed necessary for any apparent tardiness in the execution of the special undertaking of which the present work is the result, it will not be very far to seek, but may be readily found by a reference to the various and unceasing vocations in which the author of the MANUAL OF OPERATIVE VETERINARY SURGERY is habitually engaged. The labor of its preparation has, in fact, been alternated and shared with that of other literary engagements of an imperative and unremittent character, and the onerous and exhaustive duties pertaining to his collegiate functions, to say nothing of the demands of an extensive practice.

Engaged for years in the work of teaching this special department of veterinary medicine, and having abundant opportunities, which have not been neglected, of realizing the difficulties which the student who earnestly strives to perfect himself in his calling is obliged to encounter, I formed the determination long since to do what lay in me to facilitate his acquisition of knowledge; and it was then that I projected the present volume, and began the accumulation of material by the compilation of data and arrangement of memoranda, with the recorded notes of my own experience, the fruit of a long and extended practice before referred to; and of course a careful study of the various authorities who have illustrated and organized our copious veterinary literature. Moreover, haste in the publication, and a thorough digestion of the subject and the systematic ordering of material, could not be very easily combined, and a little delay in the issue will prove no detriment to the value of the book.

With his own kind permission, the work is dedicated to Professor A. Chauveau, General Inspector of the Veterinary Schools of France, as a token of my high appreciation of his services as a scientist, and in recognition of his standing among the lights of our profession; and especially of my estimation of his excellent book on anatomy, in which he so ably lays the foundation of the knowledge which constitutes the indispensable condition of all success in surgical practice.

I have been liberal with European authors, not only in freely crediting them with their discoveries and theories, and in many cases quoting literally their opinions and arguments, but especially so in adopting their illustrations and enriching the work with the artistic representations originating in their's—an emphatic manifestation of my high estimate of their value and the skill of their execution. And it is thus that the names and accomplishments of Rigot, Bouley, Gourdon, Peuch, Toussaint, Cadiot and Zundel, of France; of Brogniez and Degives, of Belgium; of Hertwig, Hering, Moller and Hoffman, of Germany; of Lanzillotti-Buonsanti, of Italy; and of Williams and Fleming, of England, will become familiarly known to our readers.

But while I have in great part been guided in my work by the character of that of our predecessors, I have not restricted myself to the lines observed by them, or exclusively respected the authority or precedents of European surgeons, but have sought to do justice to the progress of American veterinarians by honoring the contributions they have made to our surgical knowledge; and it is due to accident alone, and to no invidious design, if any omission or oversight has been committed, by which any to whom credit should be awarded have failed to receive it.

The chapters of the MANUAL which treat respectively upon "Fractures" and upon "Operations on the Foot" are reprinted from my own previous writings. Thus, in the first instance, the remarks upon fractures, with the kind permission of the Hon. Jeremiah M. Rusk, Secretary of the Department of Agriculture, are extracted from an article published in "The Special Report on Diseases of the Horse;" and in the second instance, touching the subject of operations on the foot, I have not hesitated to utilize my own translation of Zundel, produced as long ago as the year 1881. In both cases improvement has been made upon the previous treatment of these topics by the addition of numerous illustrative plates which accompany the text.

In the chapter upon operations on the genito-urinary apparatus the reader is referred to my special work on the subject of "Castration," which is not included in the present volume.

In completing the task undertaken in the preparation of the MANUAL, however perfect or imperfect may be the manner of its execution, while I have been influenced by a desire to effect something for the benefit of all classes of practitioners, including those of recent graduation, my object above all has been to facilitate the labors of the young student while industriously and anxiously toiling for the knowledge which is to qualify

him for a successful career in a useful and honorable profession; and if I shall have succeeded in this object, and the success shall be certified by the verdict yet to be pronounced, I shall feel fully satisfied and more than ever encouraged to persevere in my efforts to elevate the standard of veterinary science in America.

No toil has been spared, no effort relaxed, in the prosecution of the design and desire to compel the approval of the judicious, and even to escape the strictures of the critical, and I have not failed to seek for aid and counsel from competent coadjutors. The entire text has undergone revision, with a view to the improvement of its idiomatic structure, by my esteemed friend, H. D. Holt, M. D., of Jersey City, N. J., to whom I am also indebted for the favor of supervising the proof and overlooking the issue and arrangement of the various chapters; and my publishers, Messrs. Sabiston & Murray, have exercised a true liberality in providing an external garment and garniture for the contents of the book, in all respects correspondent with their value and interest. To these gentlemen, therefore, are due my warmest acknowledgments for whatever of internal and external attractiveness may characterize the MANUAL OF OPERATIVE VETERINARY SURGERY, and they are cordially and freely tendered.

I have now only to express the hope that this contribution to the cause of veterinary progress may be as kindly received and favorably judged by my colleagues as it is honestly designed to effect its object by me, and that any shortcomings in the execution of the work may be leniently regarded. And so it goes into the hands of the public, to share the fate of all human ventures, for better or for worse, as its fate may be.

THE AUTHOR.

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INTRODUCTION.

Under the designation of operative surgery is understood that department of medical science and practice which includes the external and instrumental manipulations required in the treatment of surgical diseases and accidental injuries or deformities; or perhaps it might be succinctly defined as *surgical science mechanically applied.*

The two branches—the science and the art—which constitute the study of operative surgery cannot, of course, be dissociated in a treatise on the general subject, and it will therefore be necessary, as we proceed with the detail of our observations, to give due consideration to the ætiology, the symptomatology, the pathology and other characteristic features of certain diseases, in their relations to the indications of treatment and the manipulations which they involve at the hands of the surgeon.

Viewed from the standpoint of comparative importance in respect to the value of the results of human and veterinary surgery, as relating to the vital status of the patients who become respectively the subjects of both—the human being and the quadruped races—veterinary surgery must of course consent to occupy the subordinate place; a fact, however, by no means tending to disparage the value or the just estimation of the calling of the scientific veterinarian.

In human surgery the one paramount result held up to view is the prolongation of the life of the patient. This is a consummation to be achieved regardless of any considerations of cost or trouble, while in veterinary surgery the prime motive is the restoration of the patient's interrupted ability to fulfil his function as an animated machine for supplying a certain amount of valuable force. For these reasons the scope of veterinary practice is

a circumscribed one, in comparison to that of human surgery, by having the aim and being brought to the test of mere economic utility. While the human life is prolonged at any cost, moreover, the treatment of the animal is always supplemented and influenced by the consideration that if curative efforts fail, the sufferings of the patient may be terminated by the administration of a prescription which will at once release him from pain and deprive him of life, with the full sanction both of self-interest and benevolent feeling.

Another element which operates to define the sphere of the veterinary surgeon is the natural disinclination of the owner of a sick or disabled animal—perhaps a man of limited pecuniary resources—in a tedious and unpromising case, to add to the expense of surgical attendance the cost of the unremunerated "keep" of his disabled and unproductive servant.

It ought to be true, as a matter of course (perhaps it is so in point of fact), that no man of intelligence and integrity will assume the duties and responsibilities of surgical practice without the due preparation and equipment, which is only to be acquired by conscientious study and competent knowledge of medical science at large. Especially and indispensably a surgeon must be an accomplished anatomist. His knowledge must be thorough and practical in the several divisions of anatomical science—he must possess a familiar acquaintance with *descriptive anatomy;* he must be fully instructed in *surgical anatomy* or the *anatomy of regions;* he must have mastered the last chapter in *pathological anatomy;* and if there are any other kinds of *anatomy*, he must master them all, and then he will have become an *anatomist* in fact, and qualified to practice surgery. Yes; a surgeon must be an ANATOMIST.

And it ought to go without saying, that only a surgeon should practice surgery, whether his patient be biped or quadruped. No untrained layman should presume to wield the knife and the cautery with their associated arsenal of weapons and other appliances for the subjugation of the enemy whose assaults it is the special province of the surgeon to repel. An ignorant operator may easily become, himself, a more dangerous "lesion" than some of those which he presumes to treat. The man who can cut into the living, and usually hypersensitive, flesh of a suffering animal, without knowing what tissue or organ he is attacking, what artery

he is likely to sever, what nerve to wound, what organ to lacerate, what function to paralyze; who would essay the operation of neurotomy without knowing where to look for the plantar nerve; who would undertake a case of vaginal spaying in ignorance of the location of the flying ovaries; or who would operate for strangulated hernia unaware of the mode of avoiding the infliction of injury upon the posterior abdominal artery—such a man, if to be found, should simply be subjected to an odium which should ostracise him from honorable and equal association with others of his species, besides being held criminally amenable to the law providing penalties for the perpetrators of cruelty to animals

These reflections may be unnecessary, but it is all too true that our domestic animals too often become the victims of worse than brutal masters, who take advantage of their helplessness and inferiority to inflict upon them cruelties so gross and aggravated that right-feeling men are often compelled to blush to call them fellows. It is no excuse for this that it is done through the agency of a pseudo-surgeon: such a plea merely doubles the number of the wrong-doers.

In offering these suggestions, and in formulating the information which follows, derived from the experiences of many studious and observant men, and which in their aggregate and connected form constitute the substance of this volume, it is assumed that it is only from competent and qualified minds that the appreciation which it hopes to merit and to receive must come, and we trust that to the extent of its justice and truth it will not be withheld.

With the skill of the expert anatomist must be associated, of course, the necessary mastery of *therapeutics* and a familiar knowledge of *special* and *general pathology*, and all should be supplemented by a knowledge of the *theory and practice* of the farrier.

The science and the application of the laws of *hygiene*, so generally, indeed almost wholly, ignored by our fathers, and so largely a discovery of the present time, will never be overlooked or depreciated by the genuine surgeon; and while possibly the effects of meteorological influences may have become of less importance than they were considered to be in times gone by, a careful observance of their phenomena will never be a useless item of acquisition. The fullest attention to the theories and application of what may be denominated the science of antisepsis, and the adap-

tation of antiseptic measures, now so universally and unintermitting an adjunct to all medical and surgical practice, and so utterly indispensable in the departments of dressing and nursing, and so often an available and valuable aid in the very act of operating, must be considered now to have become an incorporated and constituent department of the domain of surgery, and medicine as well, and the cultured veterinarian will of course so regard it in his practice.

Without being necessarily a practical worker at the anvil, the surgeon, as we have intimated, must acquire a familiar acquaintance with the theories and the art of the farrier. No one can place too high an estimate upon the importance of the position occupied by the foot among the anatomical regions where lesions may be expected to occur, and whereas the shoe becomes practically identified with the living member, and is, in use, a portion of the hoof itself, by the act of nailing the shoe and the hoof together the inference becomes palpable. An occasion may easily arise when a serious blunder in treatment may be traced to a previous blunder in diagnosis, which again may be referred to an earlier blunder still, which has consisted in neglecting to examine the foot, and the shoe which has injured it. What is the status, in respect to his market value, of a horse with poor feet, or whose good feet have been ruined by bad shoeing? So the veterinary surgeon, though not required to be able to make a set of shoes, should be expected to know how they ought to be made and fastened. And when a special shoe is required for the correction of a deformity, or as indicated in some diseased condition of the foot, it will of course become the exclusive province of the surgeon to dictate the whole process of forging and fastening, and to see that his instructions are not ignored.

Besides the special scientific attainments to which we have referred, there are many other qualifications which must enter into the character of the good and skillful surgeon, in order to round it into true symmetry and proportion. Bouley remarks that "he must not only be a man of science, but a man of art," meaning, we suppose, that he should not only possess knowledge, but know how to make it available. First, he must possess the faculty of knowing how to gauge the necessity of his interference, with its manner and its duration; or, on the other hand, whether any interference is necessary, and whether the true indication is

not to refrain entirely from active measures. The result of his decision will afford a good test and gauge of the extent to which he has profited by his clinical and theoretical study. He is a sound philosopher who can wisely determine when to *let alone*, in opposition to the temptation to *do something.*

The acquisition of manual dexterity is an accomplishment of prime importance and should be acquired, and can only be earned by diligent practice upon the cadaver, or, what perhaps is more effectual, besides being in itself real work, by utilizing every opportunity of performing minor operations, under suitable instruction, upon actual patients. Of course, expertness without practice is impossible. It is not fully correct, perhaps, to speak of *manual* dexterity in the singular number. The dexterity required should be bi-manual or ambi-dexterity, and any surgeon who has not mastered the art of using both hands indifferently, though he may have learned all else pertaining to his profession, lacks yet one thing. Cases will continually arise in which the inability to change hands may interrupt the progress of an operation and involve the practitioner in great inconvenience, if not embarrassment, and possibly prejudice the case itself.

Courage and coolness, with patience, are essential qualities of temper in an operating surgeon. To become alarmed and lose his balance on the occurrence of some untoward incident, or the appearance of some unlooked-for abnormal development or complication, or to give way to a spirit of impatience because of unexpected delays, or, especially, to resent the fractious movements of the suffering animal, writhing under the knife or the glowing cautery, is both unprofessional and unmanly. The terms courage, coolness, patience and kindness should describe his state of mind while operating.

The whole axiom of Asclepiades, *cito*, *tuto* and *jucunde*, reveals the entire scheme of conduct proper for the surgeon under all circumstances. Every movement of the surgeon should be prompt and precise. Indeed, by operating rapidly he shortens the duration, and consequently the sum of the inevitable pain, and thus diminishes the anguish of a long and torturing infliction on behalf of the patient. The maintenance of his own self-possession will make him master of the situation, and assure a neat and artistic finish to his task, with no unnecessary divisions of tissues, no mistaking of localities, and generally with no betrayals of

doubt and hesitation or awkward and aimless manipulations, such as mark the attempts of the tyro and the novice. The confidence and facility with which each movement is accomplished will not fail to impress favorably those who are spectators of the operation, and to react favorably and profitably for the operators.

Although, of course, the qualities of accuracy, neatness and rapidity must favorably impress the spectator, as well as benefit the patient, it must not be forgotten that the true success of the surgeon must find its evidence in the favorable result which finally crowns his work. If that is assured, it is but a small matter whether it is or is not applauded while in progress—the applause will follow, in any case.

We quote from Bouley, in the *Dictionnaire de Medecine et de Chirurgie Vétérinaire*, where he remarks, on another important practical point: "The operative function of veterinary surgery requires, on the part of the man who practices it, a certain corporeal vigor, associated with sufficient agility to be able effectually to overcome the resistance of animals under torture, and counteract the efforts and avoid the injuries they are always so prompt and often so dexterous to inflict upon those who are causing them pain. The veterinary surgeon must be cool-blooded and patient, never losing his presence of mind while directing the manipulations, often so difficult and so dangerous, which are necessitated at his hands, especially when the large domestic animals are under treatment. He must then—always, in fact—be prepared for all difficulties and eventualities that may arise, whether before, during or after an operation, and he must inspire confidence in his assistants by using full precautions for their safety and for his own, in his defensive dispositions against the dangers to which they are exposed."

A surgical operation, as elsewhere described, is a mechanical action, practiced with more or less rapidity upon the living body, according to certain rules, either with the hand alone, or assisted by instruments, with a therapeutical or a prophylactic object in view, whether primarily necessary or facultative, of a prophylactic nature.

It is especially as therapeutic measures that operations are necessitated in the treatment of diseases and injuries; as, for example, in the case of the removal or extirpation of diseased or altered parts, whose morbid action injuriously affects the general

health or prevents recovery from a pre-existing disease. This class of operations includes the opening of abscesses, the extirpation of gangrenous parts, or of necrosed or carious bone; or again, for the modification of the nature of a traumatic lesion, in order to stimulate cicatrization, as in the opening of a fistulous tract, or the resection of an ulcerated surface; or when the economy is to be relieved from the presence of a foreign body, or the abnormal product of a natural function, as in cases of œsophagotomy, or of calculi of the bladder, or of the salivary ducts. Operations have also their prophylactic uses, especially in the various forms of inoculation and vaccination as anticipatory and preventive of infectious diseases. They find their further obvious indications, again, in remedying physical lesions when applied to fractures, dislocations, deformities, and the endless list of accidental injuries, wounds and hurts of every kind and degree. And, finally, they have their justifiable use in mutilating the larger domestic animals, designed for purposes of labor as beasts of burden or draught, in improving their adaptability by castration or spaying, or as properly termed, "altering."

Thus the general purpose of an operation is to palliate, cure or assist in the recovery of surgical diseases; to prevent diseases, and especially such as are known to be contagious; and so to modify the condition of the domesticated animals as to enhance their usefulness and value to their human owners.

In medical nomenclature, operations are variously designated according to the methods and characteristic manipulations attending their performance, and the objects which they are designed to accomplish. Thus:

(*a*) It is a *light* operation when superficial tissues or those of secondary importance are involved, like that of venesection, or the simple puncture of a vein. On the other hand, it becomes *serious* when it is performed upon important organs, or involves extensive and complicated structures, as that for the reduction of strangulated hernia; the removal of the lateral cartilage of the foot in a case of quittor; the operation for chronic champignon, etc., etc.

(*b*) Operations are also *dry* or *bloodless* when accompanied by little or no hemorrhage; and *sanguinary* or *bloody* when, on the contrary, much hemorrhage attends any of their various steps.

(*c*) Again, they are *simple* or *complicated* according to the extent and multiplicity of the tissues or regions forming their

seat; *simple* if performed by a single manipulation, *complicated* when requiring several distinct or separate stages for their execution.

(*d*) Operations are called *regular* or *determinate* when performed according to rules in relation to the disposition of the parts, and, in general, upon sound structures; and they become *irregular* or *casual* when the manipulations are extemporized to meet the emergencies of the case, the necessity of the situation and the unanticipated complications which may arise while operating, as particularly in cases of the removal of tumors.

(*e*) They have also received various designations indicative of the time chosen by the surgeon for their performance; or made imperative by the circumstances of the case; or according to the object specifically in view: thus they are *urgent* or of *necessity* when a fatal event would be the alternative of delay, and immediate treatment becomes imperative, as the condition of the patient's survival, as in operation for the reduction of strangulated hernia, or that of tracheotomy in a case of threatening suffocation; and in cases beyond hope of complete recovery, they may become *necessary*, *indispensable*, *useful* or *palliative*, according to the degree in which they may be made available as a means of relief, and may tend to the temporary respite of the sufferer, and in some degree improve his value by measurably enhancing his ability to continue to labor with some degree of comfort before he is overtaken by a final and total disability.

There is another class of operations which justly deserves to be totally discountenanced and ignored, and in fact are fit objects for penal prohibition. They are known as operations of *fantasy* or *fashion*. They are without real utility; are abortive attempts to improve upon the symmetry of nature; are devised simply to satisfy a mere whim of affectation; are in wretchedly poor taste; and probably subject their victims to a more aggravated and protracted species of torture than any other form of wound known to veterinary surgery. There are sometimes conditions, however, in which they may lose their alleged æsthetic pretext and their artistic character, and the object of their performance may be regarded as properly within the legitimate and beneficial sphere of professional work.

The settlement of the point of the *time*, in connection with any piece of surgical work, is not always one of mere secondary

importance in deciding the matters pertaining to the details of an operation. When there is any *option* in the case it pertains wholly to the surgeon to determine the question. And when the period of abeyance has terminated by his decision in fixing the day and hour when the contemplated treatment is to be applied, the *optional time* becomes changed to the *selected time.* Of course it is not always left to the option of the practitioner to select the moment for the accomplishment of his task. He must be governed by the nature of the case, and may be left without the opportunity of exercising any discretion in the matter. The urgency of the occasion may be extreme, with no interval allowable for deliberation or choice, and the only available time, the peremptory present, must be accepted as that of *necessity.*

The operation being now obligatory, and the case understood, the surgeon's next thought is the choice of the locality of the operation, and that being finally decided, the *point of selection* has been reached. The case may easily present such features that this point becomes too obvious for hesitation by becoming that of selection as well as that of *necessity*, as indicated by the seat of the lesion or diseased process. With traumatic cases, there is, of course, but a single point of interest—it is the *point of injury!*

In surgical phraseology the terms *method* and *procedure* are often used convertibly. There is between them, however, a distinction which, for the sake of precision, must not be lost sight of. By *method* should be understood the principal and primordial mode by which the operation is performed, while by *procedure* is meant the special modifications and successive stages by which the manipulations of the operation itself are regulated. For example, in the removal of a vesical calculus there is one *method* by lithotrity and another by extraction, and with both are involved the insertion of instruments into the urethral canal, one being the *procedure* with the catheter, and the other the *procedure* by the injection of tepid water. Castration with clamps is a *method*, when compared to double subcutaneous twisting (*bistournage*) or to torsion; and it is performed by two *procedures*, that by *covered* and that by *uncovered* testicles.

There are several important points which demand special attention at the hands of the surgeon before beginning an operation. Having finally reviewed the situation, and especially having mentally rehearsed the anatomical disposition of the region and the

pathological character of the lesion, with the necessary details of the work before him, not forgetting to anticipate possible accidents and complications; and being assured that his arsenal of instruments, dressings, etc., is ample and in good and available order, with a liberal provision of sponges, antiseptics, etc., and duplicates of such of the instruments as are liable to be broken or otherwise disabled, the condition of the patient should then be ascertained. It will, of course, have been thoroughly understood by the surgeon previously, but it is always among possibilities that even at the appointed moment for operating, some changes may be discovered or some new circumstances developed which may modify or contraindicate the entire proceeding.

Some final preparation of the patient is always necessary. One item of this consists in clipping the hair from the skin over the seat of the operation, and thoroughly cleansing the part. In some cases it is necessary to soften the tissues by means of poultices, baths or wet bandages. There is also a constitutional and general preparation which must not be neglected, with a view to so modify the organism as to improve the ability of the animal to withstand the shock of the operation. If weak and debilitated, his strength and condition must be improved; if of an irritable and nervous disposition, precautions must be taken to control it. A comparatively low diet is almost always a salutary measure, and sometimes even complete diet an essential preliminary to an operation, and the surgeon must assure himself that they have been properly taken into consideration.

In many cases the surgeon needs the co-operation of assistants, either professional men or laymen. The aid rendered by a professional brother or by a student of medicine will of course be such as will be assigned to him by the responsible surgeon, and cannot be specified here—it will vary with every case. The facility and success of an operation will be greatly promoted by their intelligent and sympathetic aid, which will be quite of an indispensable character. In enlisting laymen as assistants, it will of course devolve on the surgeon to instruct them as fully as possible in the nature of the services expected from them; and in making his selection of individuals it will be an important point gained if he can obtain those who are accustomed to the management of animals, and who are expert in handling and successful in controlling them.

There is still another party to be considered while referring to the study of "preparation." It is neither the animal, the surgeon, the assistants, the instrument case, nor the lint and bandages. It is the owner of the ailing animal. And to "prepare" *him* for the event is oftentimes a performance requiring a larger amount of judgment, tact, knowledge of human nature and patience than the average man possesses. On the one hand there are those of the optimist class who have quite an unwarranted opinion of the power of surgery, and who, in despite of the most unfavorable prognosis, insist upon a resort to the knife, even upon inadequate occasions. And on the other hand are those who interpret any suggestion which involves a solution of continuity professionally proposed, however artistically consummated, as only a mild form of sentence of death to the patient. But however antipodean may be their views in other respects, they are in common quite assured that for an operation which fails to restore the dilapidated patient to a condition a little better than new, whatsoever may have been the accident or lesion which he may have encountered, and whatsoever may have been the skill and intelligence exhibited in the treatment of his wounds or ailments, the only legitimate and orderly conclusion is a suit at law for malpractice. It is the function of the doctor to cure disease; if he treats disease without curing it, he is an incompetent; this is the irrefragable logic! Though the living animal had failed to return any remuneration for his subsistence, and for the care lavished (?) on him during the period of his disability, yet when reduced to the state of a cadaver he should be compelled, if possible, in an indirect way to net his bereaved owner a sum likely to prove largely anodyne to the poignancy of the grief which the loss of so much property had excited.

But aside from this, the owner of the living property, the value of which is about to be jeopardized, is entitled to a full and candid statement of the nature of the case, with its possibilities and its dangers, and it is in the interest of the surgeon himself to observe perfect frankness with his employer—not, however, to the extent of compromising his position as *doctus* in the case, or foregoing his self-respect by making concessions upon points of scientific acquisition to a layman, however generally intelligent or specially interested. The surgeon must assert himself as the representative and exponent of an honorable and learned profession, able

and prepared to acquit himself of his just responsibilities; and, indeed, it is in this assumption by him, with the conceded assent of the owner, that the virtue of the contract lies, which binds the two parties with equal force, moral and legal.

This point, being understood and settled, should be looked upon as furnishing the best preparation which the owner can acquire, and he will need no other when he is thus made to understand that he must have full confidence in the skill which he has called into requisition, and must be guided by its implied guarantee that every possible precaution will be taken to carry the patient through his trouble; and that if accidents of any nature should occur, when not incurred through carelessness or error, the risk is the owner's, and he alone must assume it. Such an understanding on the part of the owner will impose upon the honorable surgeon an imperative sense of the conscientious care with which his task should be performed, while at the same time it will relieve his mind from the pressure of a possibly embarrassing anxiety while engaged in his work, and it cannot fail to be of advantage in various ways to all the parties concerned.

Minor matters, such as the condition of the weather, the time of day, the selection of a place, the position which the operator must assume for himself, with that which he assigns to the patient—these are points which are also to be carefully taken into consideration. They have, one and all, more or less influence on the facilities of execution of an operation, and perhaps also on the results that may follow it.

CHAPTER I.

MEANS OF RESTRAINT.

The final preliminary before operating upon animals, is to place the patient in such a condition of restraint as will assure the entire safety of the surgeon and his assistants from injury likely to result from the violent struggles of the terrified and suffering creature. The severity or the duration of the operation furnishes no accurate measure of the necessity of the restraint, or of its continuance or degree. Any unusual or violent aggressive treatment will excite his fears, and consequently his opposition, and whether the occasion be a painful and protracted dissection, or the simple application of a dressing, the surgeon may usually rely on the strenuous resistance of the patient. It is of little account that there are differences of dispositions in horses, as in men. With any unreasoning animal the case is the same, and with the excitement, the anxiety, and no doubt, a vague terror of something unknown impending, too often quite explainable by the treatment to which he has been long accustomed at the hands of an unfeeling owner, he is prompted by the mere instinct of self-preservation to defend himself with such means as nature has taught him to use. The necessity of enforcing a passive condition in the animal being thus apparent, it ought not to be necessary to say that the means of accomplishing it should be employed with reserve and moderation, especially when they are painful in themselves, and that no man claiming to be the possessor of humane instincts will permit himself to increase the severity of their application by supplementary ill treatment, in the infliction of "punishment," upon the alarmed and suffering brute, a course which is quite likely, moreover, to be as ill judged as it is otherwise reprehensible, from the fact that in most instances its effect is contrary to its intention, in aggravating the evil it would remedy. It should never be forgotten how easily the most fractious and timid animal may sometimes be controlled by kindness and patience, and his agitation soothed by

the sound of a familiar voice with which he has become accustomed to associate acts of gentleness and friendliness. Under any circumstances, a habit on the part of the surgeon, of brutal treatment, the exhibition of a bad temper, in the indulgence of fits of anger, leading to acts of cruelty in the infliction of unnecessary pain on his dumb and helpless victim, is not only in every way useless, as being of no possible advantage in any direction, but tends to a degree of moral harm in those who are thus culpable for which no counterbalancing benefit can be imagined, and which certainly can never facilitate the remedial effect—but quite the reverse—of the pending operation.

A benignant method of controlling animals for the special purpose for which treatment by the surgeon is invoked, is not, however, alone sufficient, and it is thus that a resort to effective means of physical restraint becomes unavoidable.

These are of two kinds: one consists in inflicting upon some given part of the body, more or less remote from the seat of the operation, a severe and continuous pain, which, by a process of derivation, reduces that which is incident to the steps of the operation, by distracting or diverting the consciousness from the influence of the new suffering, against which he feels resistance would be in vain, to that of which he is sensibly cognizant, and thus the animal submits himself, with a comparatively voluntary surrender.

The other kind consists of restraints proper, and are constituted of mechanical devices for securing immobility by the process of overcoming opposition by means of a dominating physical force. Their use is not affected by the position of the subject, and they are therefore applied in both the upright and decubital posture. The first comprehends the *derivative* or *painful* method of Peuch and Toussaint's division; the second, the method by direct *mechanical restraint.*

MEANS OF SECURING SOLIPEDS.

A.—Derivative or Painful Method.

This method is in very common use, and usually proves to be sufficiently effective to secure a degree of quiet and passivity in the patient for the safe performance of many light operations. Under some circumstances it is used in connection with the means

of direct restraint. The instruments mostly employed in the first method consist of the twitch, the old fashioned barnacle, and the gag.

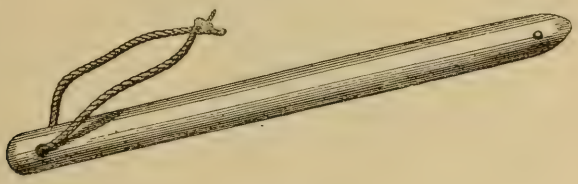


FIG. 1.—The Twitch.

The twitch is the instrument most commonly used and, unfortunately, too commonly abused. In horses, it is sometimes applied on one of the ears, and sometimes on one of the lips; and is very severe in its action, wherever applied.

In applying it, the operator, passing his right hand through the loop of cord of the instrument, grasps the tip of the upper or the mass of the lower lip, leaving the loop to slip over his fingers close to the skin which it then encloses, and with his left hand turns the handle of the instrument until the cord is sufficiently shortened to form a true ligation of the tissues which it circumscribes. The pain caused by this constriction may be graduated by the rotation of the handle of the instrument. When in place it is either held by an assistant or tied on the halter. If the animal proves to be especially refractory under the infliction, the assistant should be cautioned against aggravating the trouble by forcibly dragging upon or jerking the instrument, violence of that nature becoming in some instances the cause of severe injuries to the muscular or nervous structures of the lips. We have ourselves met with several cases of labial paralysis resulting from such an improper and repeated application of the twitch. Sometimes the length of the wooden portion of the instrument is considerably reduced, varying in its application in such a way that when the open loop is placed on the lip the wooden part which takes the place of the handle is placed on the lips through it, and the cord is twisted by turning it.

The *barnacles* are formed of two articulating branches, made of either wood or iron, with sundry notches at one end and a ring at the other to fit into the notches. The degree of pressure required is regulated by shifting the ring until the proper notch is

FIG. 2.—Short Twitch.

ascertained. The iron instrument is severe in its effects, probably more so than the twitch, but is less easy of application. In applying the barnacles, the surgeon grasps the upper lip, and placing

FIG. 3.—Iron Barnacles.

each of the branches severally on opposite sides of the organ, brings the ends together, immediately fixing them in place at the desired point of pressure, and secures them by fitting the ring into the proper notch.

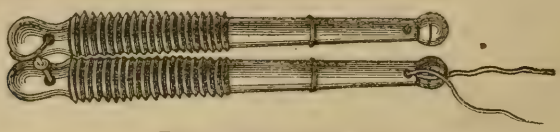



FIG. 4.—Wooden Barnacles.

The *wooden* barnacles are made with circular sharp ridges cut in both branches in order to intensify the pain, the ends, when they are approximated, being secured by means of cords.

The *gag* is a means of derivation used principally in Central Europe. It consists of a cord about one-quarter of an inch in diameter, which is placed in the mouth, and passing upward on each side of the face, is tied on the top of the head. This is twisted to any degree of tightness by means of a small, round piece of wood, which is passed between the cheek and the cord, the result being excessive traction upon the commissure of the lips and great

FIG. 5.—The Gag.

pain to the animal. Lacerations of the commissure, or wounds of the skin at the poll are to be anticipated if this manner of punishment is not guardedly used.

There are besides these some milder appliances which must not be overlooked. Among them is the repeated pricking of the tip of the nose with a pin, and the introduction of foreign bodies, such as musket balls in the ears. The origin of this last method dates back to 1607, when little round stones were recommended for the same object. When musket balls are used, holes should be drilled through them for the insertion of a string, in order that they may be withdrawn when necessary.

B.—Mechanical or Restraint Method.

The means employed in this method vary according to the position, whether upright or recumbent, in which it is desirable to confine the animal during an operation.

STANDING POSITION.

The necessity of imposing restraint upon the patient while under treatment in the standing position arises not alone from the danger of injury to the operator and his assistants, from the biting and kicking of the excited animal, but because he is so thoroughly impartial in the distribution of his attentions that he even requires protection from his own violence, and his own flesh must be guarded from the contact of his own teeth.

They are usually resorted to in order to facilitate operations of comparatively trifling importance, and which are not of a particularly painful nature, or are of easy and rapid execution, or

under circumstances when the animal can be controlled by being merely held by the head against a wall, or with the hind quarters in a corner, or perhaps tied to a wall, a post, or a tree. Certain minor precautions are necessary on these occasions. For example, the ground on which they stand must be smooth, though not slippery; of a good holding character, and neither too hard or too damp, in order to avoid falling, or slipping, or other possible accidents. Attention to these matters will be of great benefit to the operator by leaving him a good foothold, with facilities for freedom of movement, and more at liberty to guard himself against his patient, unexpected changes of attitude.

The means by which the movements of the head are kept under control are the *halter*, the *bridle*, the *bridoon* and the *cavesson*—instruments which need no description here. If the animal is left unconfined, the assistant having passed the rope of the halter or bridoon through his mouth, holds him close to his head, places himself in front of him, or slightly on one side, and being attentive to every movement the animal may attempt, anticipates it, by pulling the head downwards if the animal is about to rear, or raising it upwards to prevent him from kicking with his posterior legs, or inclining it to one side or the other, as the animal moves it in one or the other direction.

An animal should never be tied with the halter-rope in his mouth or over his nose. There is danger in both methods of serious accidents, in case of a violent backing or jerking of the head. In one case the result might be a section of the tongue, and the other might involve a fracture of the maxillary. For similar reasons the bridle is also dangerous. The height at which the head should be secured must vary with the movements attempted by the horse. Thus, to prevent him from rearing or striking with his fore legs, it should be placed low, but high when it becomes necessary to guard against his elevating his posteriors in order to kick with his hind legs.

To protect his head against possible self-inflicted blows resulting from his defensive struggles, and to prevent him from seeing surrounding objects likely to alarm him, are precautionary items of not a little importance, and the employment of the mask or cap (Fig. 6C) is very effectual for that purpose. Fractious patients, dangerous to handle and difficult to control, often become perfectly quiet and thoroughly docile on finding themselves involved in dark-

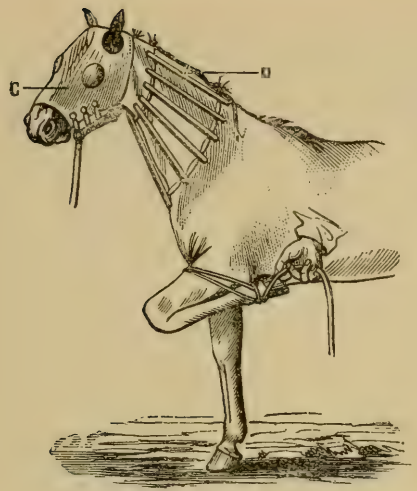


FIG. 6.—C, the Cap. O, the Cradle.

ness, and submit to the necessary manipulations of the surgeon without further resistance. When a proper cap is unobtainable a bridle with blinders can be substituted, or a blanket placed over the head. Biting the attendants may be prevented by applying a muzzle,

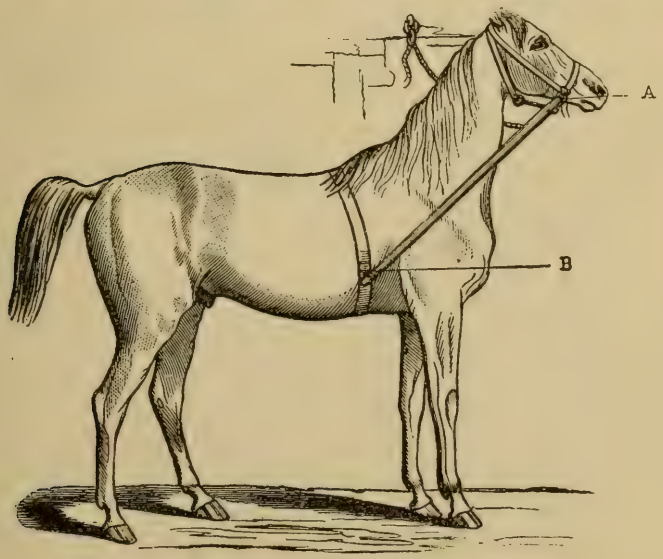


FIG. 7.—The Side Bar.

and he may be protected from his own teeth by the use of the cradle (Fig. 60) or *beads*, or the *side bar* (Fig. 7AB). With the cradle around his neck, the horse is prevented from carrying his head on either side ; its use, however, must be carefully watched lest the friction of the cord, which secures it in place upon the superior border of the neck, should cause severe complications by chafing or even cutting through the skin. Peuch and Toussaint have reported one case of fatal tetanus from this cause, but no such accident ought ever to occur, for the means by which it may be avoided are easy and obvious, protecting the border of the neck with pads. The side bar prevents the flexure of the neck toward the side upon which it is placed, and when in use during an operation is applied on the side occupied by the operator. It is used both singly (on one side only), and doubly (on both sides).

The danger of accidents arising from the unrestrained mobility of the head of the animal being thus guarded against, those which may be caused by striking and kicking with the feet are next to be considered. In many instances it may be sufficient to simply raise the foot from the ground, and to keep it thus suspended by holding the leg in a position of flexure (Fig. 6).

No violent measures are necessary in order to obtain such control over the movements of the horse as are consequent upon compelling him to support his weight on three legs only. The method of raising the foot and keeping it off the ground is a matter too familiar to every stable hand to need detailed instructions. But a little art may be necessary, with a little compulsion added, to induce him to continue to sustain the *role* of a tripod long enough for the purpose of the operator. But this cannot always be depended on, and therefore when he betrays an evident unwillingness to submit quietly to such a confinement of the foot, the compulsion of the ropes or straps must be resorted to. For the fore leg the strap is attached below the fetlock and passed around the forearm, and either buckled or held in place by an assistant. When the rope is used it is passed around the coronet, the leg flexed and the rope either passed round the forearm and secured in the same manner as the strap, or thrown over the withers and held by an assistant on the opposite side of the horse. For the hind legs the rope, plaited rope or *plate-longe*, is necessary with the hobble. These are applied in different ways.

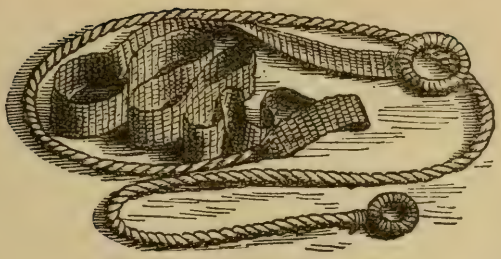


FIG. 7*a*.—Plaited Rope.

In the *first* method a hobble is placed on the coronet of the foot to be raised, with the buckle outward, and the ring looking backward; then a loop made at the flat end of the plate-longe is

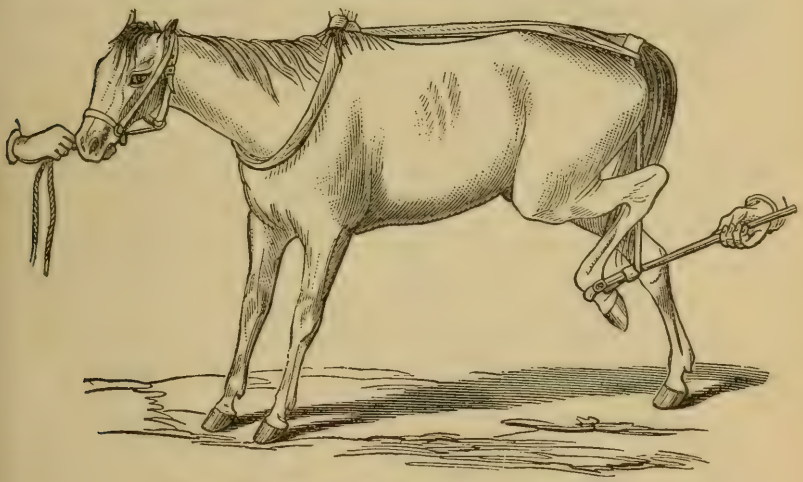


FIG. 8.—Securing the Hind Foot with Rope and Hobble.

passed around the neck; the rope is then carried along the back, and with a single turn around the tail, is passed through the ring of the hobble, from within outward. Pulling on the rope raises the foot and carries it backward, where it is held by the assistant.

Second.—Sometimes the hobble is dispensed with, and the rope is passed from the neck straight to the coronet, where a double twist is made, and the foot controlled as before (Fig. 9).

Third.—In other cases, the plate-longe is secured to the tail, instead of around the neck, conditioned of course upon whether the tail is sufficiently long and furnished with hair of the strength

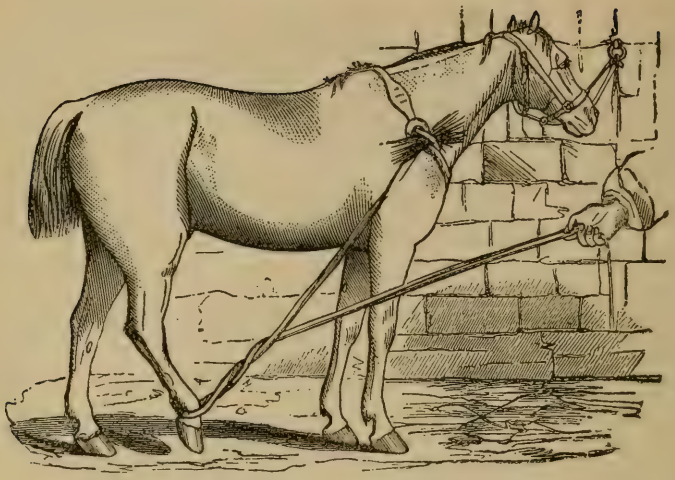


FIG. 9.—Securing one Hind Leg with Rope only.

necessary. When matters are favorable in this respect, the operator proceeds as follows: a loop being made at some distance from one end of the rope, it is laid flat on the top of the tail, close to its origin, and the short end being twisted around that extrem-

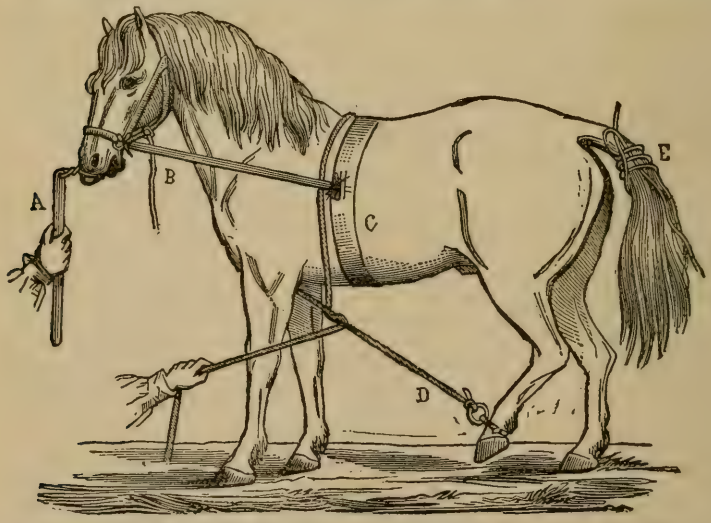


FIG. 10.—A, The Twitch. B, Side Bars. C, Surcingle. D, Securing Hind Foot. E, Fixing the Rope on the Tail.

ity with from two to four turns, and the remaining portion passed through the loop, and the other, or longer portion of the rope, drawn taut, the knot is tied and the plate-longe thus firmly secured. As in the two previous methods, by drawing upon the longer end of the rope the foot can readily be raised and held in position, either with or without the hobble.

There are occasions, when, although it may not be required to have the leg and foot held up for the purposes of the operation, it still becomes necessary to do so in order to prevent the animal from using his feet as weapons of combat, or to restrain him from motion.

The plate-longe, and the single or double side-line, with one or two hobbles, are then put in use, for the purpose of either raising the leg from the ground and compelling the animal to stand on three, or again to prevent motion in the posterior biped. For example, in one case the flat part of the plate-longe is

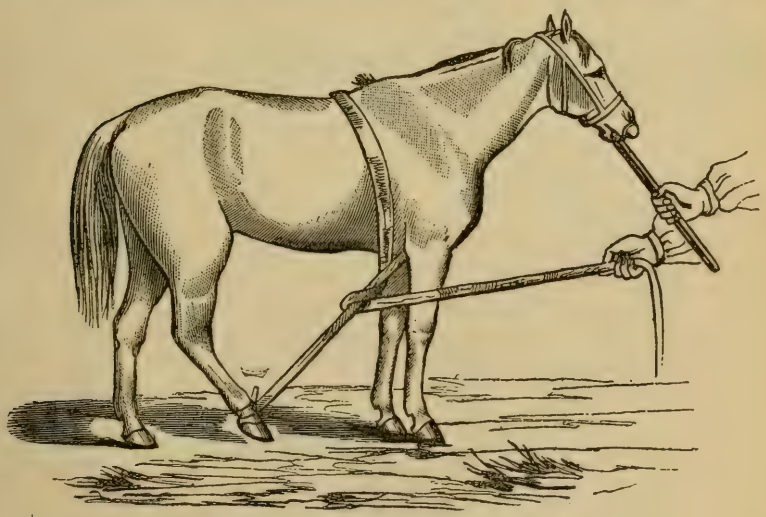


FIG. 11.—Another Means of Using the Rope.

passed with a loop around the coronet of the leg to be kept steady, the rope is then carried forward between the fore legs, then on the side of the neck opposite to that of the leg to which the plate-longe is fixed, over the withers, back to that side, and twisted around itself behind the elbows, as it passes between the fore legs (Fig. 11).

In other cases a large loop of the plate-longe is thrown over the neck, and the rope carried back to the coronet of the foot to

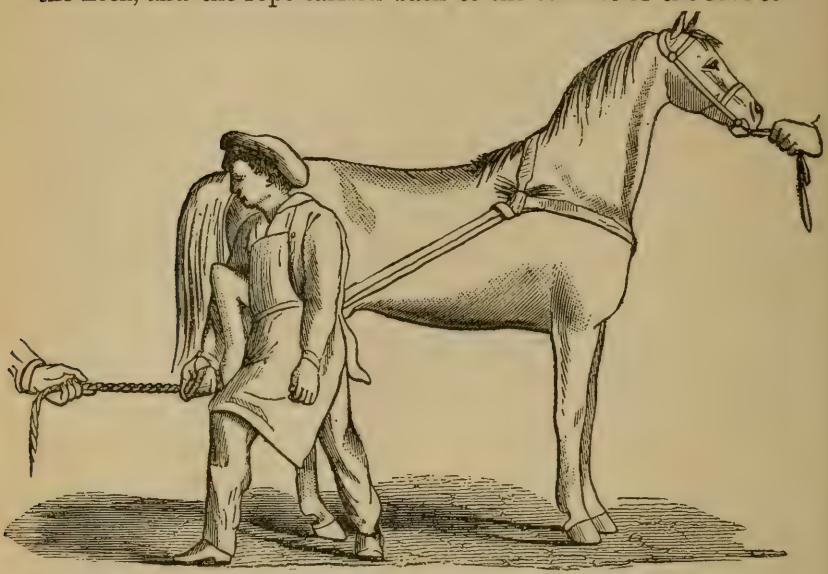


FIG. 12.—Securing and Holding a Hind Leg with Rope.

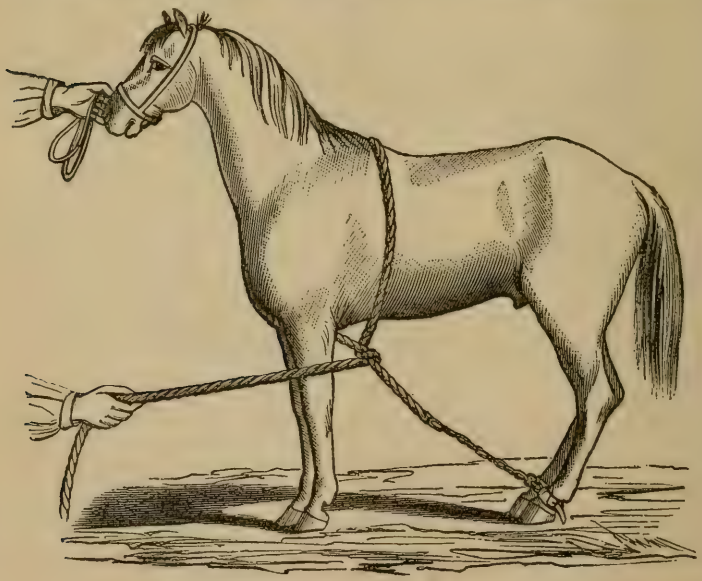


FIG. 13.—Securing both Hind Legs with Hobbles.

be secured, and by one or two twists around itself, is brought backward, where it is held by an assistant. Sometimes a single hobble is placed on the coronet, and the rope of this side-line runs through its eye, which is turned forward (Fig. 12).

To prevent the animal from kicking with both hind legs, a King hobble, carrying the chain, is put on one leg, and the chain passed through the eye of another hobble placed on the other hind leg, and the rope carried forward and secured as in the case of raising one single foot, viz., between the fore legs, on either side of the neck, over the withers and then after being twisted around itself back of the elbow, held by an assistant (Fig. 19). In some instances a double side-line is used, the loop being thrown over the neck, and the ropes carried backward, one towards each hind leg, and passed through the eyes of hobbles placed on them, and returned forward, where they are secured with a slip-knot to the loop of the side-line on each side of the neck.

For the same purpose, of securing the two legs of a biped, whether anterior or posterior, LeGoff has invented a peculiar apparatus, consisting of a Y-shaped rope, single at one end and bifurcated at the other, each of the three ends having a running noose or loop. If the two hind legs are to be secured the loops of the bifurcated portion are placed on the coronets of these legs, and the loop of the single portion secured on one of the fore legs. If on the contrary, the fore legs are to be confined, the arrangement is simply reversed.

Another excellent method of limiting the movements of the animal to prevent him from kicking, and keep him quiet, is to take a plate-longe, and beginning on one of his sides, at the girth, for example, pass it forward across one forearm, a little below the elbow, in front of him, on the other side across the other forearm; then backward across the thigh, or a little below it, then passing it back of the animal, to the first side across the other thigh, to return to the starting point (Fig. 14). Passing the rope through the eye of the flat extremity of the plate-longe, the legs can be comparatively well kept together. To prevent the rope from dropping too low, it is thrown over the back and secured on itself on the other side by a knot. This part of the rope over the back supports the two horizontal portions which run on each side of the animal and keeps them in place.

This mode of restraint is but a simplification of the apparatus

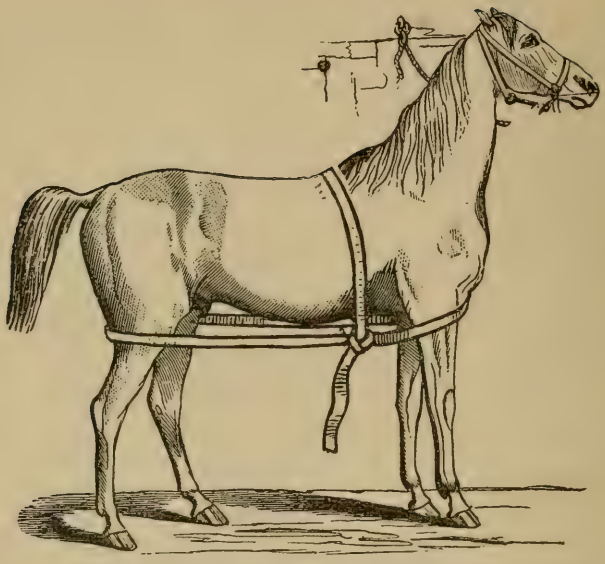


FIG. 14.—Securing all the Legs, with Rope all around the Animal.

invented by Raabe and Lunel—the hippo-lasso (Fig. 15). This apparatus is called the *straight jacket* for horses, by the inventors, and is composed of a strong breast-piece or Dutch collar, and a breeching, placed over the withers and the croup. The breeching carries on each side, firmly sewn on, a long strap, and at each point, B, an iron eyelet. The breast-piece at B, carries also on each side an iron eyelet, and on the front strap a strong buckle. To place it in position, the Dutch collar is thrown over the neck and the breeching laid over his rump. Both straps of this part of the hippo-lasso are passed forward through the iron eyelet of the breast-piece at B, back through that of the breeching at B, and then forward again to be buckled, more or less tightly, at *b*. The length of the strap of the Dutch collar piece which passes over the neck, and that of the croup, must be regulated in such a manner that the horizontal position of the lasso is for the fore legs, but a little below the forearm, and between the stifle and the hock for the hind legs.

The hippo-lasso is an excellent means of restraint, and may even be utilized for vicious animals upon which operations would otherwise be impossible, except by throwing them. In shoeing

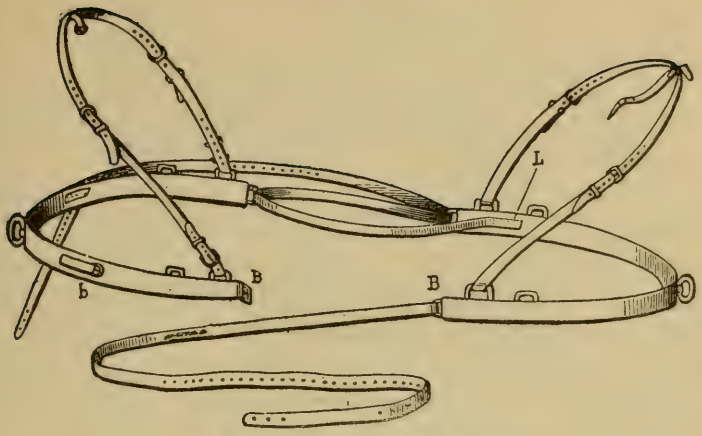


FIG. 15.—Hippo-lasso of Raabe & Lunel.

vicious and clipping nervous horses it has given most excellent results.

Among other varieties of apparatus used for controlling animals in the standing position, are the various machines known as *stocks* or travis. They are of many forms, and consist of heavy wooden frames, firmly secured in the ground, with peculiar arrangements for supporting the animal in slings, if necessary. They are padded on the inside, for security against injuries and have on one of their narrow sides a system of iron bars, against which to secure the feet when the animal is raised from the ground. The stock illustrated in Peuch and Toussaint's work (Fig. 16), will give a good general idea of one of the most approved forms of this means of restraint. The stock of E. Winsot (Figs. 17, 17a and 18) is another form, which can be used for securing the animal in either standing or laying position.

RECUMBENT POSITION.

Notwithstanding the many advantages attending the application of the means already described, devised for securing the immobility in the standing position of animals undergoing surgical treatment, there are circumstances in which their efficiency becomes wholly lacking. Sometimes it is because of the invincible restiveness of the animal, but more often because of the serious nature of the pending operation, which may require for its safe

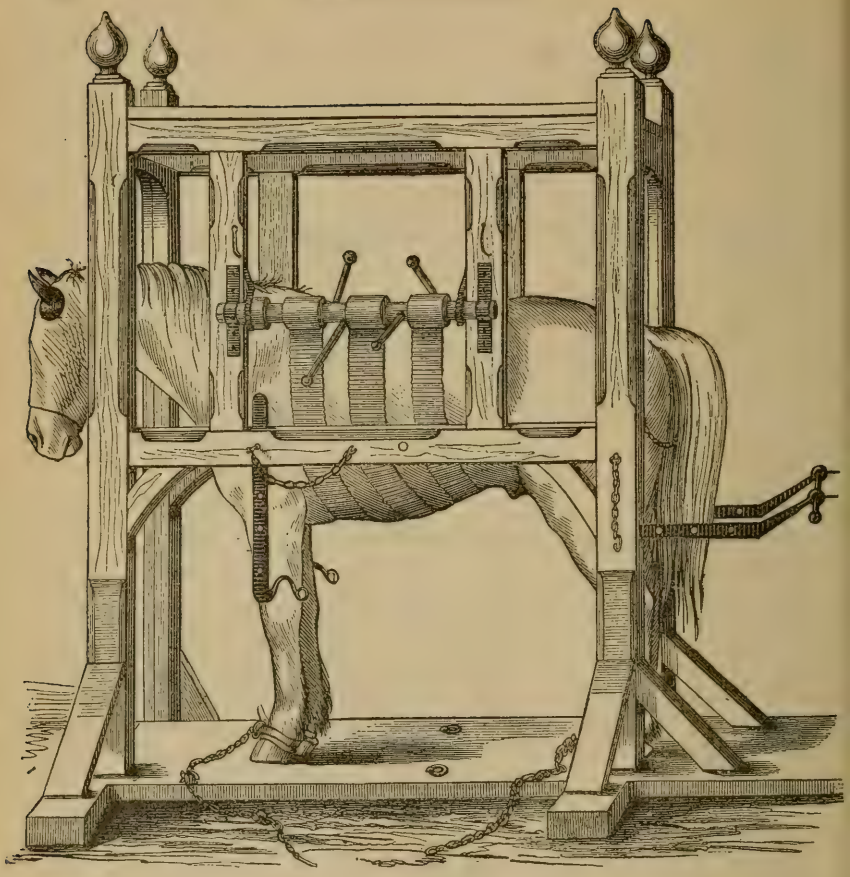


FIG. 16.—The Stock.

performance a degree of deliberation and an amount of dissection of the most painful character, with which only the most absolute passivity, if not complete unconsciousness, is compatible. In this class of cases the recumbent position in the patient becomes simply an indispensable requirement.

To *throw* or *cast* a horse signifies simply to apply the force necessary to compel or induce him to lie down, and to continue in that position during the pleasure of the surgeon. The forms of compulsion by which the desired result is to be effected are next to be considered.

It would be improper to construe the word "throwing" as

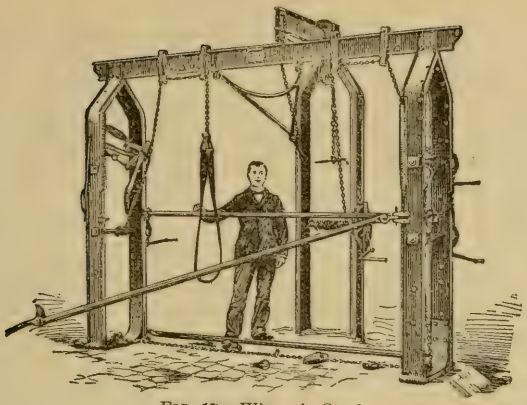


FIG. 17.—Winsot's Stock.

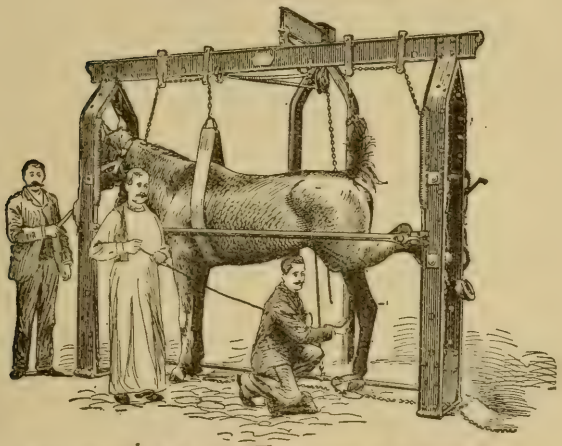


FIG. 17*a*.—Firing a Horse while Secured in Winsot's Stock.

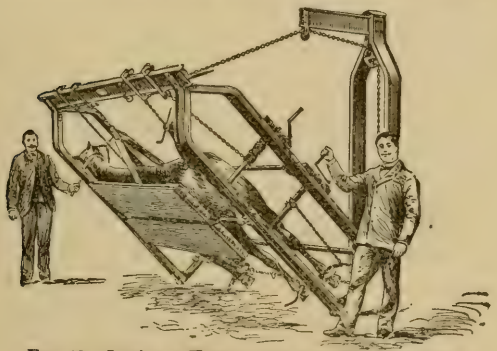


FIG. 18.—Laying a Horse Down with Winsot's Stock.

literally designating the act of violently casting down, as in a wrestling match. On the contrary, it must be qualified as referring to a method of so manipulating the patient and directing his movements as to bring about a change of posture with all the appearances of a voluntary act on his part, which indeed it essentially becomes.

The preparation of the *bed* upon which the animal is thrown, and of its location, will require some judicious attention from the surgeon. A convenient place, with sufficient space to allow perfect freedom of movement about the patient, such as a large yard, a barn or an open field will fulfil the requirements. The ground should be smooth, and, if possible, soft—a pasture lot or farmyard, or a manure heap often offering good facilities for the purpose in country practice. In any case it should always be covered with a layer of straw, sawdust or tan bark of sufficient thickness to prevent a violent concussion when the patient falls, and ought to be sufficiently wide to allow him to fall as nearly in its center as possible. Its dimensions should be approximately from nine to ten feet square.

An important point in its construction is that it should be free from any hard foreign substances, such as stones, bones, pieces of wood or iron, etc., for fear of contusions or other similar lesions against any parts of the body of the patient.

Several methods are in use for throwing a horse, among which are the peculiar apparatuses known as the *hobbles.* The *ropes and the operating tables* are also used. The previous preparation of the animal for the operation ought not to be forgotten. This usually consists in a fast of not less than twelve hours, and will always be found to be a good measure.

A.—Casting with Hobbles.

These are of various kinds. Some are made of leather, others of rope, but they are all constructed upon the same principle. The English style, invented by Bracy Clark and afterwards improved, which are in most general use, present so many advantages in their facility both of application and removal from the legs after the operation, that we shall limit our consideration to them alone (Fig. 19).

A set is composed of four hobbles, a chain and a spring hook. Each hobble is formed of two straps of leather of unequal length, the shortest (*a*) having attached on one end a strong buckle (*i*),

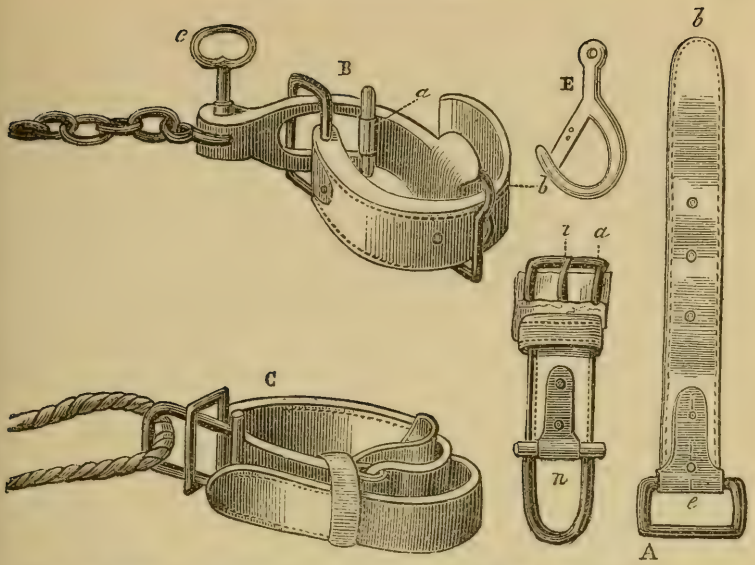


FIG. 19.—English Hobbles. A, Hobble Unbuckled. B, King Hobble. C, Hobble in Position, with Rope through the Eye.

and at the other an iron eyelet, narrow and somewhat elongated (*n*), the eyelet of the longest (*b*) being somewhat square in form (*e*), in order to allow the ring (*n*) to pass through it, and having in its

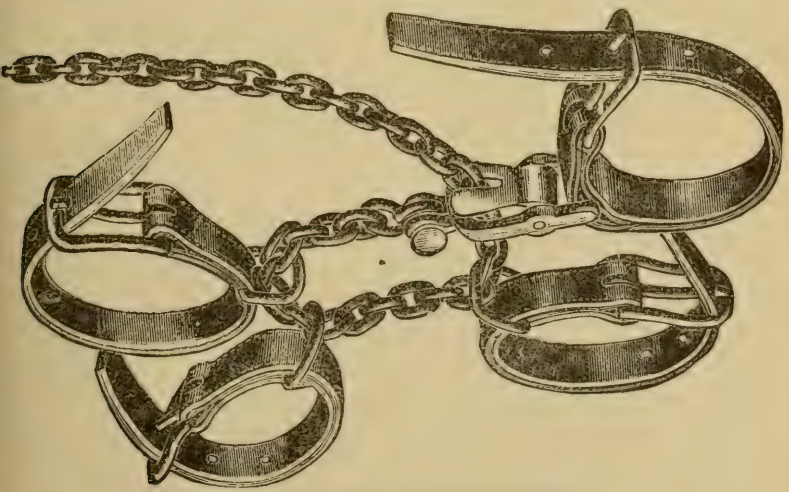


FIG. 19*a*.—Self-locking Hobbles of Prof. Barker.

length a number of holes to allow it to be buckled with the short strap. Three of each set are of this construction. The fourth, which is the *main*, *chief* or *king* hobble, differs from the others in the form of the iron eyelet of the shortest strap. In this hobble it is made of a peculiar shape, and with a small slot, through which the chain is passed and secured by a pin-screw running through it. The chain belonging to this set measures four or five feet in length, and has spliced at one end a casting rope some fifteen feet long. At the other end the link of the chain is flattened and made to slip easily through the slot of the main hobble.

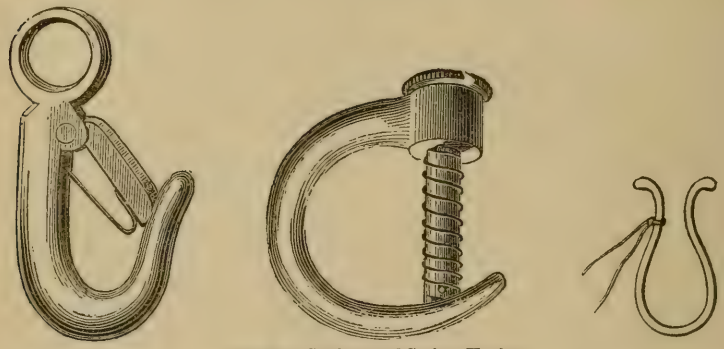


FIG. 20.—Spring and String-Hooks.

There are many forms of spring-hooks used. In our own practice we use two strong spring padlocks, as being of easier application and less liable to liberate the animal by becoming loosened or breaking.

Besides the set of hobbles, a long plate-longe and a Bernardot & Buttel apparatus are necessary. This consists of a wide and strong surcingle, having on both sides two straps, joined together in front, and a strong halter, which from the nose-band carries another strap, which passes in front of the head, between the ears, through an iron ring on the pole-band of the halter, and is to be buckled to the single strap of the surcingle. By shortening this strap, the head and neck are placed and kept in as much extension as may be desired.

Preliminaries being completed and instruments ascertained to be in efficient condition, the horse is placed at the side of the bed; and we may here repeat that the manipulations which are next to succeed are not designed to throw him off his feet with a violent

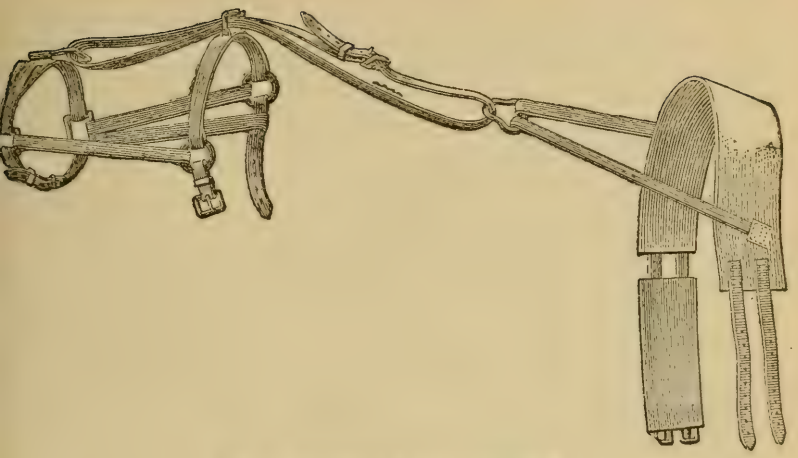


FIG. 21.—Bernardot & Buttel Apparatus.

shock, but simply to place him in a posture of such discomfort, and so to disturb the center of gravity that lying down becomes an instinctive act, and is done voluntarily, in order to avoid the act of falling; it may be termed a voluntary compulsion.

When brought to the bed, a cap is placed over his head, and all the hobbles are applied, simultaneously if possible, by four assistants acting in concert. They should carefully observe that the large buckle of each hobble is placed on the outside of the leg, and that the eyes of the straps are turned toward the center of gravity of the animal, those of the front hobbles looking backward, and those of the hinder hobbles looking forward. The chief hobble must be placed on the fore or hind leg of the side opposite to that on which the animal is to lie.

The application of the hobbles on a timid and restive horse is not always an easy matter. Remembering, perhaps, some similar experience at some former period, he rebels, resists and kicks as a natural consequence. If speaking soothingly and kindly, and employing the usual tranquilizing and assuring processes, with the raising of one of the fore feet, fails to quiet and control him, a twitch is placed on his nose and left on until, at a preconcerted moment, the hobbles are put in place; quickly, but as noiselessly as possible, the chain is passed through the ring of the chief hobble—on, say the fore leg for facility of description—then through the ring of the other fore leg, back to the ring of the hind leg of

the same side, through the ring of the other hind leg, and back to the slot of the main hobble, where it is secured by the pin-screw. The Bernardot & Buttel apparatus is then put in place and buckled by an assistant, with the surcingle on the side of the patient *opposite* to that on which he is to be made to lie. Previous to this, another assistant will have passed a long rope around the body of the animal a little back of the withers, and with still another holds it on what will be the *under* side when the patient lies down. Still another assistant is placed at his head, to aid the one who holds it, while yet another grasps the tail, and two others seize the casting rope.

The second step of the operation is to reduce the animal's base of support as much as possible, by bringing the four feet together. To do this, the operator, standing in front of the assistants who hold the casting rope, has each hind leg in succession raised slightly from the ground and carried forward by the assistant having it in charge, a gentle traction being made at the same time upon the casting rope, in order to shorten the length of the chain passing through the hobbles, the assistants at the head meanwhile gently backing the animal still more to reduce his area of support, until the equilibrium is so nearly lost that the animal

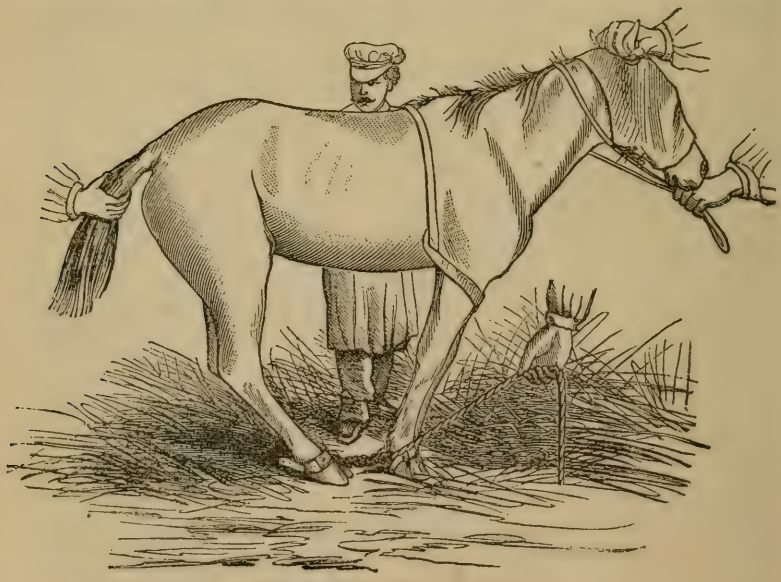


FIG. 22.—Horse about to be Cast.

instinctively abandons the effort to keep his feet, and assumes the recumbent posture in order to avoid the shock of a heavy fall.

H. Bouley recommends that the first movement in this final step should be an attempt to back the horse, in order to move the fore legs first, and then to bring the hind legs forward, if the base of support is still too broad. The twitch should now be removed; in fact, the most prudent plan would be to remove it the moment the hobbles are in place

The final step of the act of literal *throwing* or *casting* being accomplished, the last indication remaining to be fulfilled is to secure the patient in the most favorable position for the surgeon to perform the important work of which all that has been undertaken has been but preliminary. It is properly the permanent (for the time being) adjustment of the body in such a manner as to allow the surgeon the best possible access for all his manipulations to the region which is to be the seat of his dissections and other operative movements, without any unsteadiness or opposition.

Bouley's directions for this purpose are that the operator, watching for the right moment, as the horse begins to totter, gives orders to the assistants having charge of the ropes acting on the body, the tail and the head, by a prompt and simultaneous action, to pull in the direction of the side on which the animal is to lie, and to those at the casting rope to pull firmly but not harshly in the opposite direction, while he himself pushes the body of the animal towards the bed. By this arrangement of opposing tractions the casting is easily effected; but unless the assistants act in perfect concert, and especially if the casting rope be drawn too rapidly and suddenly, the animal will be raised from the ground with a sudden lift, to fall so heavily on the bed as to possibly subject him to the risk of sustaining severe injuries.

Bouley remarks on this point: "An animal is properly cast only when, bending his knees, he lies down softly and easily on his side, bringing to the ground successively the shoulder, the ribs and the hind quarters; or again when, the fall beginning from behind, the order is exactly reversed."

Once down, the forcible traction upon the chain brings the four legs in close proximity, the spring hooks or padlock passing through the link nearest to the ring of the hobble through which the chain passes, coming out last. To provide against the possi-

ble breaking of that portion of the chain which embraces the four hobbles, Peuch & Toussaint advise the passing of the casting rope and chain a second time through the rings of every hobble before it is secured with the spring hooks. The animal being down, the straps of the Bernardot & Buttel apparatus are buckled, and the head well extended on the neck. The use of this apparatus considerably diminishes the difficulties involved in the contention of the head. Before its introduction, two assistants were required to keep it in extension and comparatively motionless; and even then the results were not always easily reached nor accidents avoided, whereas, with this halter and surcingle arrangement a single strong assistant is sufficient to secure control of the head;

FIG. 23.—Horse Thrown and Secured by Bernardot & Buttel Apparatus.

and it has the advantage, besides, of "preventing fractures of the vertebral column, rupture of the diaphragm, and rupture of internal viscera."

In some exceptional cases the surgeon will be obliged to improvise his hobbles. This may be done by fastening four ropes of suitable length around the coronets, allowing sufficient room for the passage of the casting rope between the hobbles and the skin, or again placing an iron ring through these loops of rope, which are secured by a knot on the outside of the leg, as suggested by Mr. Dneubourg.

The removal of the hobbles and of the other apparatus employed in casting the animal, demands similar care and attention to that which was required to put them on. While the Bernardot & Buttel surcingle is unbuckled, the assistant loosening the

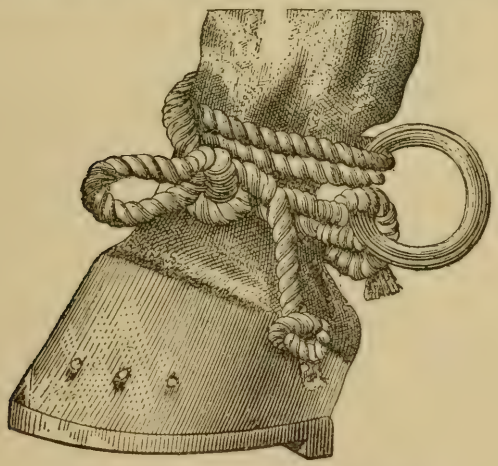


FIG. 24.—Improved Hobbles of Dneubourg.

straps of the cap, and ready to remove it at a moment's notice, the operator placing himself facing the soles of the feet, in order to be out of danger, cautiously unscrews the screw-pin which fastens the chain to the principal hobble, and removes it, when all the hobbles becoming loose, are removed, and the animal being freed from all restraint, is allowed to rise.

While the animal is rising it will be but prudent in the bystanders to allow him all the scope he may choose. The action is sudden and somewhat violent, and he may move his hind legs

with a sudden jerk which may throw the hobbles off with force sufficient to severely hurt some unguarded spectator upon whose person they might infringe. We have been witness to such an occurrence, when they were thrown a distance of twenty feet, with violence sufficient to inflict, possibly, dangerous injuries.

An animal thrown and secured as has been described is in a suitable position for the majority of operations, such as those about the head and neck, of the body, or of the upper part of the legs. But in many cases, it is necessary to fix a leg in a peculiar position either to expose a given region of the body, or when the limb itself becomes the seat of operation. The action of securing the animal in the recumbent position is one of great importance, and none of its details ought to be overlooked. And there are several points to which we have already referred in our introduction, which may be again noticed with advantage. Bearing in mind the accidents which may result from keeping the horse in a state of painful passivity, and his instinctive struggles to free himself, not to mention the painfulness of the constrained posture itself, the inference is palpable that it is incumbent on the surgeon to release the suffering patient from his trying constraint at the earliest moment consistent with the proper completion of the operation. Again, in securing the legs, care must also be taken that, although a given position of a leg may facilitate the movements of the operator, it is not justifiable if there is another mode of securing the same object by means more comfortable and less dangerous to the patient, as well as easier for the surgeon.

An experience of many years has taught us that six principal modes of fixing an animal's leg, fulfil all necessary requirements, and that the special purposes and effects of these are such as to forbid their modification.

In considering these six specific modes, it will promote facility of description if the reader will follow our references to the different legs on a sort of mental diagram which by a mode of abbreviation by initials will designate—supposing the animal to be thrown on the near side—the *near anterior* as N.A.; the *off anterior* as O.A.; the *near hind* as N.H.; and the *off hind* as O.H.

First position—Exposing the inside of the N.A. leg.—A loop of the plate-longe is secured on one of the fore legs, above the knee, say the off leg, carried in front of the near leg, under it, back and between the fore legs, always above the knee, to return

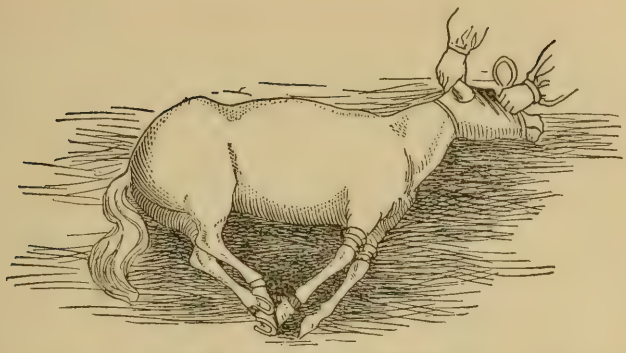


FIG. 25.—1st Position. Neurotomy.

to the starting point, around the off leg again, back to and between the legs, thus forming a complete figure 8. This is repeated twice or three times, when a turn around all the crossings of the rope between the legs ties up all the twists of the rope and a double slip-knot is made on the forearm of the off fore leg. Both legs thus secured, the near leg is released from the hobble, and carried forward by an assistant pulling on it with a rope tied around the foot.

For reasons already stated, we consider this position as the only one justifiable for neurotomy on the inside of the off leg, or for tenotomy. Firing on the inside of the coronet for ringbone, or along the tendons, might also be performed in this position.

Second position—Securing the off fore on the off hind leg.—The loop of the plate-longe is placed on the O.A. leg about the middle

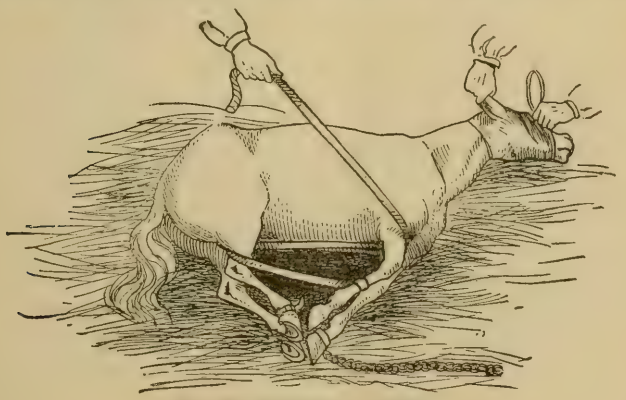


FIG. 26.—2d Position. 1st Step.

of the cannon region, from there carried backwards over the O.H. leg, above the hock, between both hind legs, and forward, between the fore legs and reflected back over the forearm, about its middle, when it is given to an assistant stationed at the back of the animal. An assistant is placed in front of the animal, kneeling on the bed, and prevents the rope which passes in front and over the forearm from slipping down too rapidly. The leg being released from the hobble, the operator holding it carries it backward, while the assistant at the back pulls *slowly* but *steadily* on the rope, the action of this lever of the first kind, with its fulcrum on the O.H. leg, the resisting power at the foot of the animal and the moving power at the forearm of the off, moves and draws the leg backward until it reaches the cannon bone of the hind leg. At that moment, steadily holding everything in place, the rope that is passing above the hock on the near hind leg is allowed, cautiously, to slip below the hock, and the near fore leg is then brought to the middle of the near hind cannon bone, where it is secured with a double figure 8. Other surgeons secure the fore leg above the hock as in the plate we borrow from Peuch and Toussaint (Fig. 27). The danger of injury to the tendo-Achilles has caused us to change that position to the one

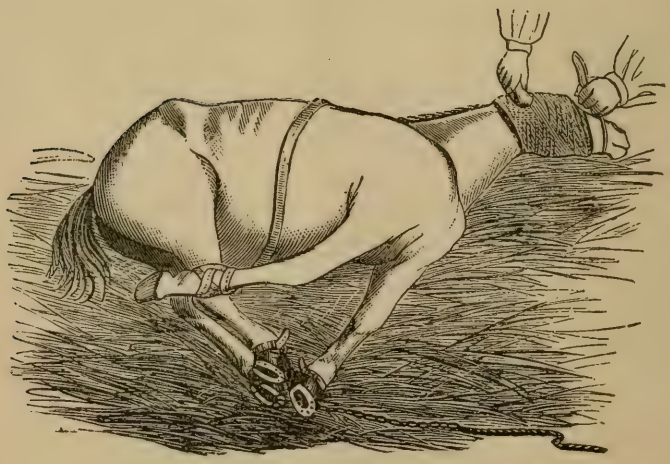


FIG. 27.—2d Position. 2d Step.

above described. In this position the inside of the N.A. leg is exposed, and it can be fired, either for disease of the knee or of the tendons and bursæ. All operations upon the foot of the O.A. can be performed except those required on the inside of that foot, such as those for inside quarter-crack, complicated suppurating corn or inside cartilaginous quittor.

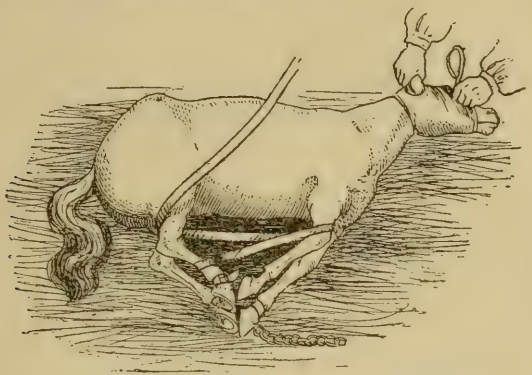


FIG. 28.—3d Position. Securing Upper Hind to Upper Fore Leg.

Third position.—Securing the off hind upon the corresponding fore leg.—In this the rope is first secured in the middle of the off hind cannon region, carried forward and over the forearm, above the knee, in front of the forearm, back between the fore legs, between the hind legs and over the near hind leg, above the hock, to the assistant stationed at the back of the animal. Removing the leg from the hobble, and pulling on the rope the near hind leg is brought, by the same method, to the middle of the off fore cannon, where it is secured with a figure eight twist of the rope. In this operation the inside of the near hind leg is exposed from the hock down, and in that position, operations on the inside of the hock can be performed, such as firing for spavin, thorough-pins, curbs, and cunean tenotomy, as well as firing on the inside of the tendons, or even tenotomy. As far as the off hind leg is concerned, only operations on the foot are justified, with the exception of those on the inside of that part of the leg.

Fourth position—Securing the near fore on the off hind leg.—The rope is secured by a loop on the middle of the cannon of the near fore leg, which rests directly on the bed, carried backward over the off hind leg above the hock, back between the hind legs,

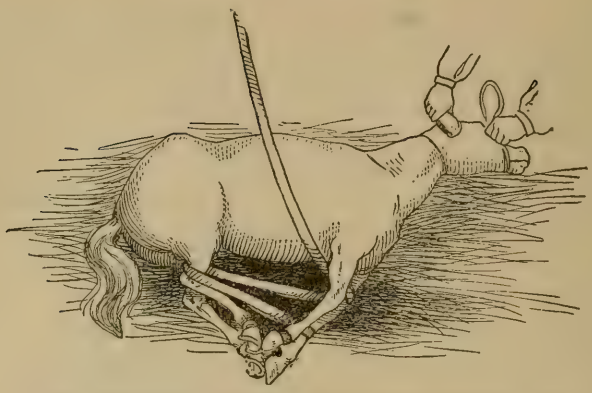


FIG. 29.—4th Position. Securing Under Fore on Upper Hind Leg.

forward *under* the forearm of the near fore leg, between the fore legs and back to the assistant at the back of the animal. In this action it again becomes a lever of the first kind, with the fulcrums above the hock, the resistance at the lower part of the near fore leg and the moving power at the forearm. The leg is drawn from its deep position to a superficial one, and secured with a figure eight on the middle of the near hind cannon, and not above the hock, for reasons already considered. This position is only justifiable for operations on the inside of the near fore foot, such as complicated quarter-crack, complicated suppurative corns, inside cartilaginous quittor, and the like. The peculiar awkwardness of this position, in which the leg is carried in excessive adduction subjects the animal to the danger of severe

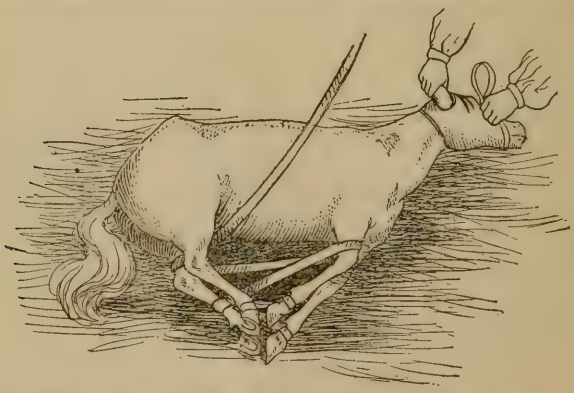


FIG. 30.—5th Position. Securing Under Hind on Upper Fore Leg.

lesions in the axillary region, and it is justifiable only in the cases specified.

Fifth position—Securing the near hind on the cannon of the off fore leg.—The rope is first tied up by a loop on the middle of the near hind cannon bone, forward over the forearm of the off fore leg, between the fore legs, and back to under the near hind leg, between the hind legs and to the back of the animal, where it is held by an assistant. The leg is again drawn from under him, is steadily brought to below the knee of the off forearm and secured as in the other positions. In this position the only operations to be performed are those on the inside of the digital region, or rather of the foot of that leg.

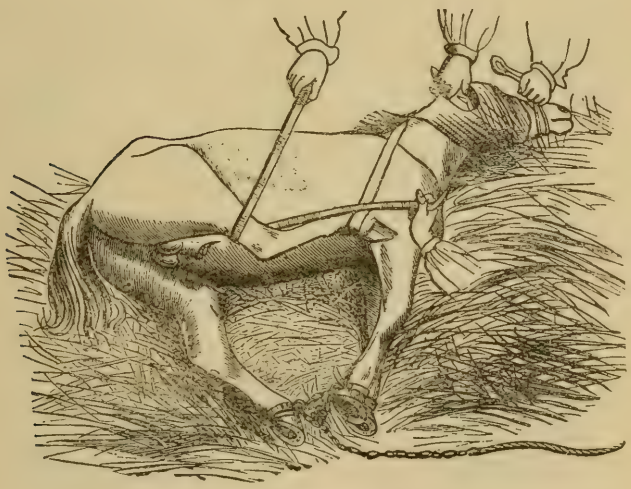


FIG. 31.—6th Position.

Sixth position—Securing the off hind leg near the neck or shoulder of that side of the body.—The rope is tied up by a loop around the coronet of the off hind leg, that is below the fetlock, carried forward toward the superior border of the neck, under the neck and then toward the inferior border of that region, back over the whole length of the animal to the front of the hind legs, between these and over the tibial region of the off hind leg, where an assistant holds it to the back. Other assistants, pulling on the rope, and making it slide as it passes on the borders of the neck,

the operator carries the leg forward until it reaches the outside surface of the shoulder, or the lateral parts of the neck, where the rope is secured by a double twist and knot around the coronet of the near hind leg displaced. This awkward and painful position is for operations in the inguinal region, including castration, inguinal hernia, removal of champignon, amputation of the penis, or removal of tumors.

When the operations which have necessitated these various positions have been completed, the leg which has been restrained should be returned into its proper hobble, and this should be done slowly and carefully, avoiding any unnecessary motions or noises, and the animal relieved of his means of restraint as in all other operations.

FIG. 32.—Side Bar Hobbles.

In a few instances, however, aside from these various modes of securing individuals, the surgeon has recourse to the *side bar* hobbles, which carries a hobble of its own at each end, one hobble being fixed on a fore, the other on a hind leg. Some of the English veterinarians are using the *cross hobbles*,

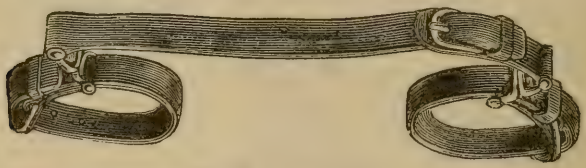


FIG. 33.—Cross Hobbles.

which has the advantage of being adapted for use upon legs diametrically opposite, such as the near fore and the off hind legs, and *vice versa.*

B.—Casting with ropes.

The hobbles are not the only kind of apparatus devised for throwing horses, nor are they all made according to the English pattern, although the same general principles prevail in all. Ropes in the form of side lines, either single or

double, are often substituted for hobbles, and for many varieties of these special claims are made by their inventors, or by those who give them their preference, and use them in their practice. Without entering into the consideration of the comparative merits of these various methods, which vary, not only in nearly every country of the world, but even in different sections of the same country, there is a mode of their application, upon which we have a word of comment to offer. This is the mode with a single, and that with a double rope.

(1st.) *With a single rope.*—This is the simplest mode of casting, but it is also the least safe. It is the oldest of the methods in use, but has in our days been more or less modified and improved. The method of Rohard seems to be as perfect as any of them. In this, a rope from twenty to twenty-five feet in length is necessary. The horse being placed near the bed where he is to be thrown, is held in the ordinary manner. If he is to lie on the near side, the operator is placed on the right, near the shoulder with the rope, in which is a knot about six feet from its end, which Rohard calls the *ring knot* (*a*), and immediately below it is another, called the *stopping knot* (*b*), through which the rope will run. "In this way," says Rohard, "there is a large loop

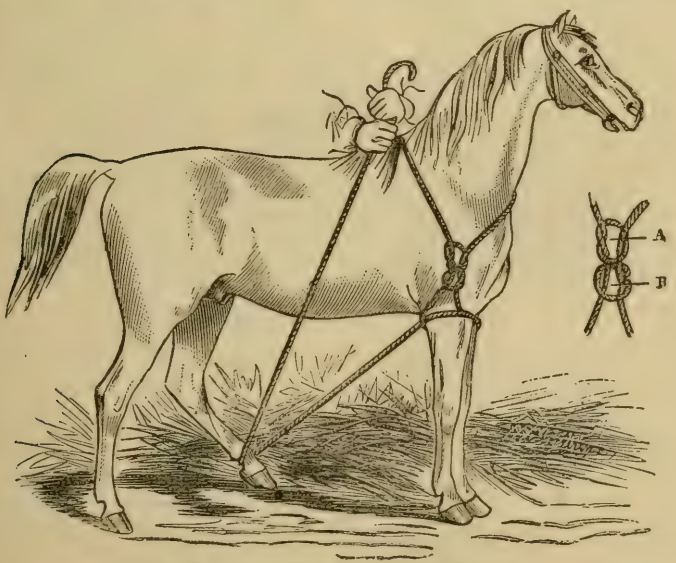


FIG. 34.—Application of the Rohard Method.

formed, which is thrown over the neck, while both knots made lie a little below the point of the shoulder." Taking with the free portion of the rope, a twist round both forearms, passing behind them first, then forward across the near fore leg, in front of both fore legs, and backward across the off fore leg, over the rope, it is carried across the abdomen, to the near hind coronet, which it surrounds from without inwards, to be brought back to the posterior part of the withers on the near side, where the operator takes hold of it. Then by degrees slowly pulling on the rope, and making the animal raise his near hind leg by quietly urging him, this leg is carried forward, with a uniform movement, until at one moment, the animal attempting to resist or struggle, the assistant at the head carries it toward the bed, the operator pressing with his body against that of the animal, until he slowly settles down without injury on his side. To fix the leg definitely,

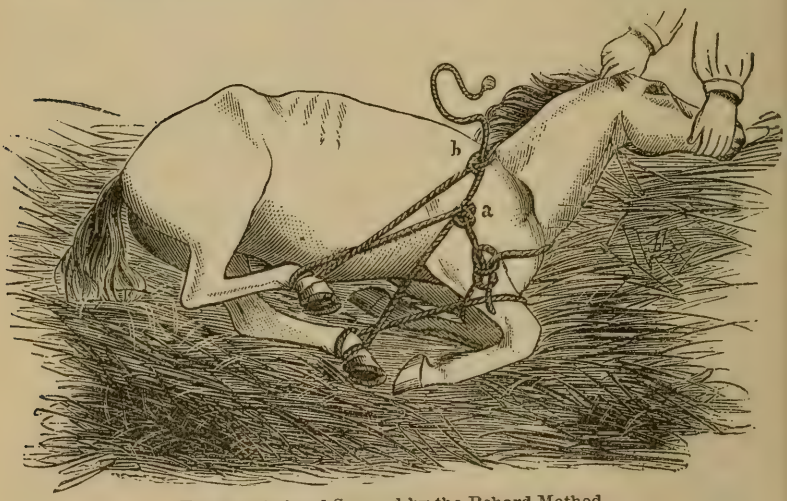


FIG. 35.—Animal Secured by the Rohard Method.

one begins by the near hind leg. Making a double twist of the rope around the coronet of that leg, this is carried towards the loop which passes around the neck, and is there secured by a double knot (*a*), and carried back to the off hind leg, which is then carried far forward and secured to the same collar loop, with a single knot (*b*). To release the animal, it is merely necessary to untie the stopping knot, when the rope becomes loosened from the legs.

(2d.) *With double side lines, or two ropes.*—This is done by means of a long rope, doubled in its middle, and having a knot made in such a way as to form a loop large enough to be drawn over the head and neck of the animal; the two ends below the knot are then passed in front of the chest and between the fore legs, carried, one to each hind leg, around the coronet, turning it once around the main rope, and passed on the collar loop from within outwards, to strong assistants standing on each side of the animal. By steady pulling both hind legs are carried forward, until the animal loses his balance and settles on his haunches, when a strong effort of the assistant at the head brings him down on the bed. The hind legs are secured to the collar loop with the ends of the rope, and the fore to the hind legs in the same manner.

The various methods of casting which we have been considering, with hobbles and with ropes are, as we have before said, not the only plans recommended. Almost every country of Europe, while also using the hobbles, has a fashion of its own in which the ropes are utilized, and as to the fact of their widespread, if not universal use, it would seem that not a few veterinarians of extensive practice have originated and employed special methods of their own devising, for which they claim more or less superiority. Among those recommended in this country, we may mention the apparatus of Mr. Miles, which he has used for years in his extensive practice as castrator. Dr. Wm. Dougherty, of Baltimore, has sent us a set of rope-hobbles and side-line, which upon personally testing we are able to recommend as possessing important points of excellence, especially in casting young colts for castration. For further light and broader information on this subject we must refer our readers to the standard authors by whom it has been discussed in the French, German, Danish and Russian tongues, feeling at the same time quite confident that the general rules which we have suggested and illustrated for the performance of the operation of casting are sufficient to guide any intelligent operator through all the steps of the proceedings.

C.—Casting on the Operating Table.

The necessity of employing such a number of assistants in throwing a horse, with the difficulties often encountered in conducting all the steps of the operation, and the accidents which

too often accompany its execution, have led to the invention of other means of accomplishing the object in which the objections to the old method are sought to be obviated. It was with this view that the operating-beds of Lafosse in France and Hart in Wurtem-

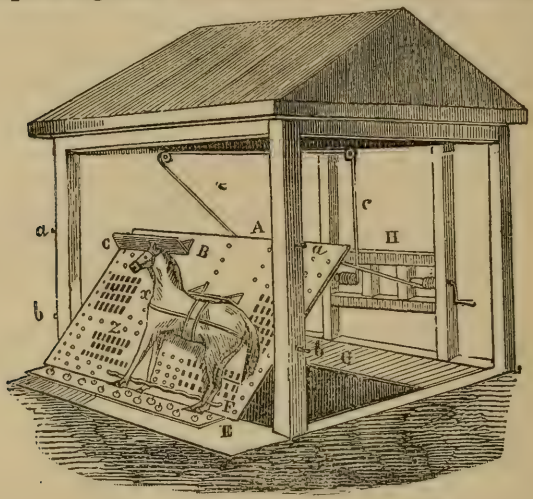


FIG. 36.—Wall-bed of Fromage de Feugré

burg were contrived. The wall-bed of Fromage de Feugré possessed many advantages, but was abandoned on account of its complicated structure. Of late years, however, several other forms of operating tables have been devised, of which one especially is highly commended by European authors. It is that of Mr. J. Daviau which consists of a broad and heavy table, furnished with pads, surcingles, hobbles, ropes and other necessary appurtenances for securing the animal, and which is moved by a peculiar crank arrangement which permits its adjustment in any required position, from the horizontal to the vertical, and by which it may be turned down flat upon an iron frame. The apparatus is placed solidly on the ground, or can be made movable by a set of low wheels attached to the heavy wooden frame upon which the table and the crank are supported.

Mr. Daviau claims for his invention: 1st. That it obviates "all the complications" accompanying the ordinary system of throwing. 2d. It allows "the easy and comfortable rising of the horse" after the operation, without danger. 3d. It gives entire security to the operator, who can perform his task alone and without the

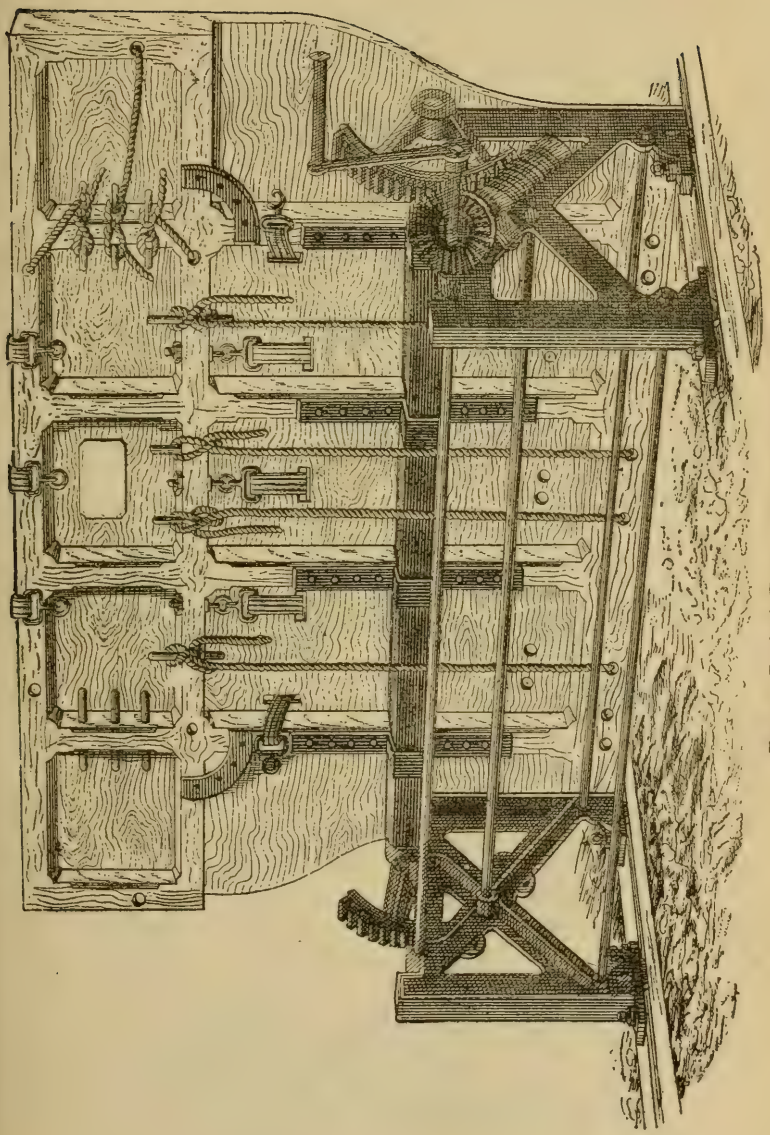


FIG. 37.—Davlau's Table. Full Back View.

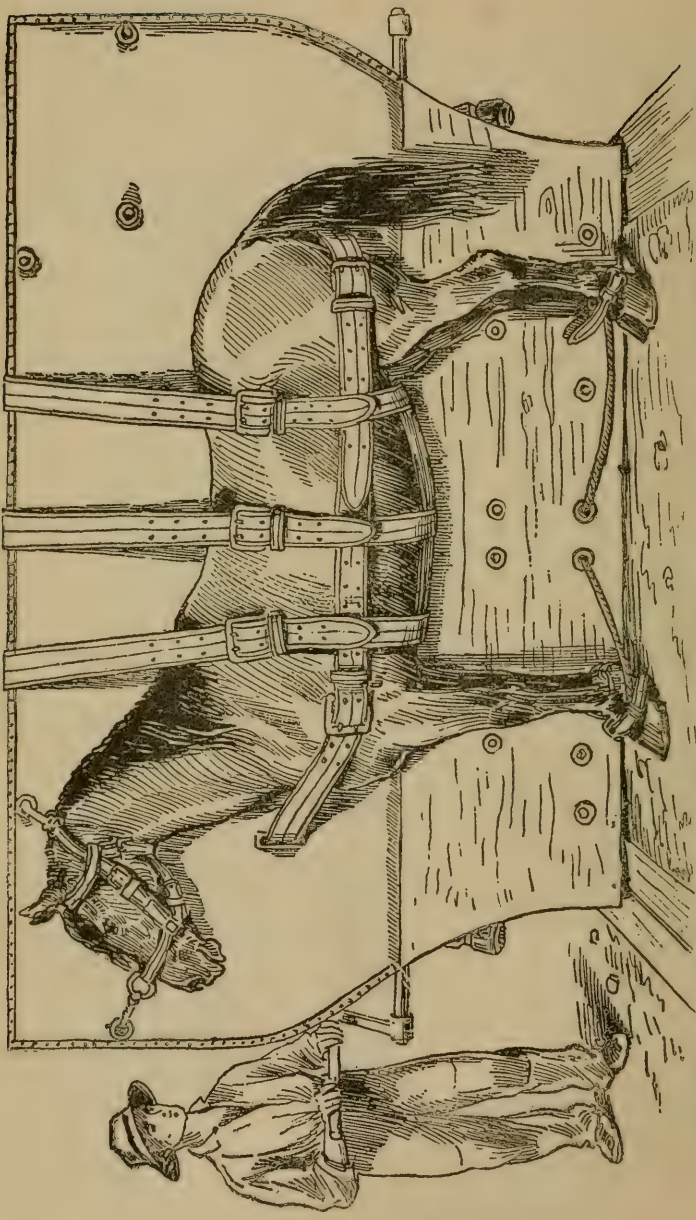


FIG. 38.—Darvian's Table. Front View. Animal Strapped and Secured; the Assistant Ready to Turn the Crank and Move the Table.

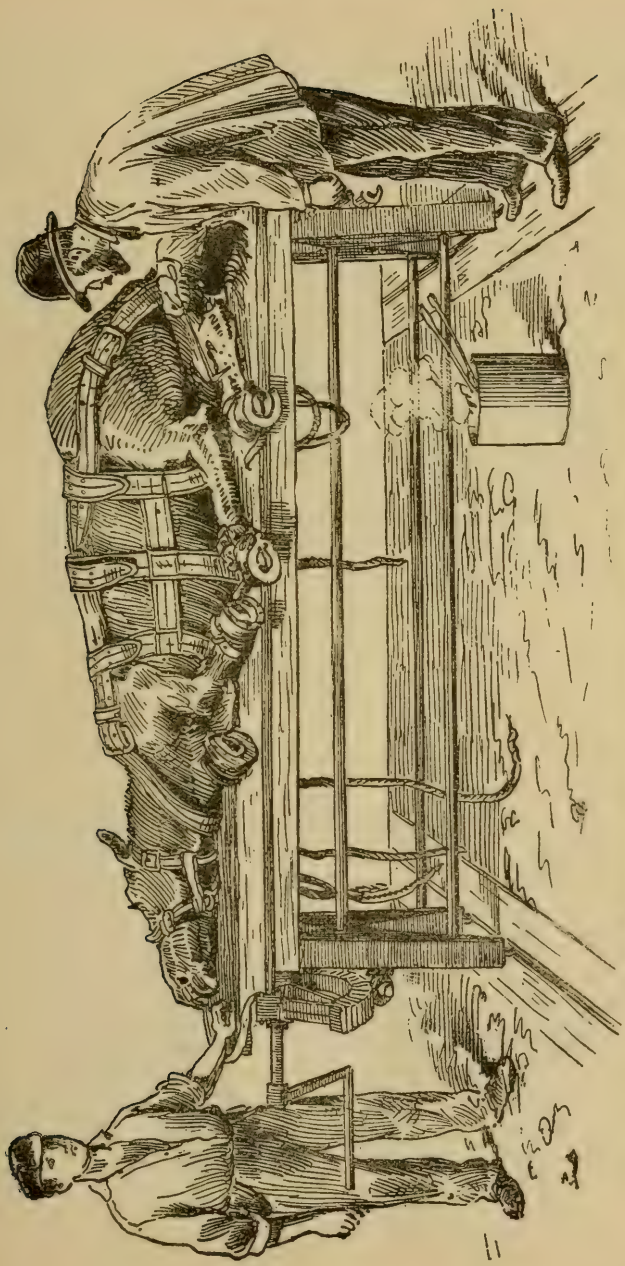


FIG. 39.—Daviau's Table. The Animal in Position, and Undergoing Operation.

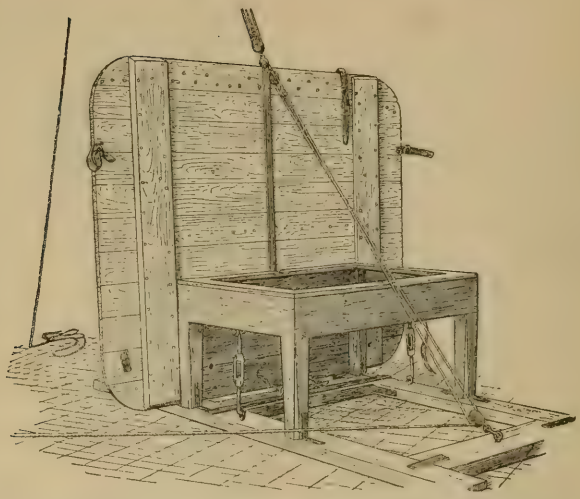


FIG. 40.—Hodgson & Magee's Table. Back View; showing the working of pulley to draw the table down.

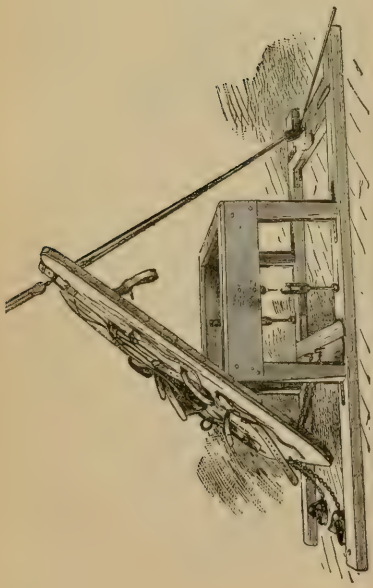


FIG. 40a.—Table drawn in an oblique position.

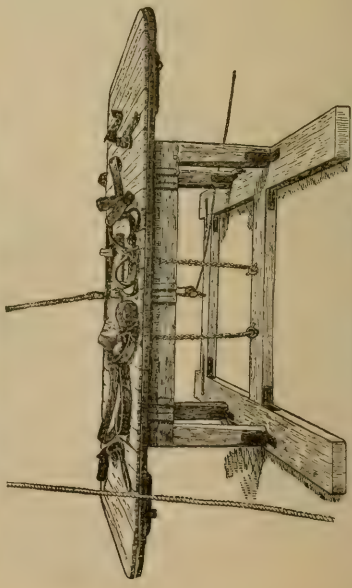


FIG. 40b.—Table in a horizontal position.

need of assistant. 4th. No assistants are needed to be exposed to danger, and the responsibility of the operator is diminished. 5th. Economy of time. 6th. Economy of material and space for the performance of the ordinary operation of casting.

In this country several forms of tables are in use. Those of Dr. Tiffany, Price and others, all of which are constructed somewhat upon the same principles with respect to the action of an iron crank to control the position of the table. Doctors Hodgson & Magee, both veterinarians of New York, have invented a table which for simplicity seems to surpass any one we have yet seen (Fig. 40). Like the others, it has slings, ropes, hobbles, pads, etc., but differs from them in two important particulars. The first is the manner in which the table is lowered and raised; the second, the manner in which the hobbles are secured and made immovable. In the middle of the superior border of the table, and directly below it on the posterior face, are two solid iron rings. In the ceiling of the operating room, or on the cross-piece of the frame in which it is enclosed, and directly opposite that in the border of the table there is another. Another is fixed in the floor some distance back of the frame upon which the table rests when in a horizontal position. To these rings two systems of pulleys are attached, one connecting that in the ceiling with that in the border of the table; the other connecting the ring on the posterior face of the table with that in the floor. Besides this, under the table are two strong iron eyelets through which chains are passed, which at one end are secured to the hobbles by openings through the table, and at the other are secured from slipping through the ring by a wide T arrangement, secured on the last link. These chains measure the distance which exists between the rings on the floor and the table when in a horizontal position.

When the horse is brought alongside the table and tied up with the slings, the halters and head-straps securing him, and the hobbles being in place, the rope of the upper pulley is pulled by an assistant, and the table moved slowly into the proper position. The rope being then fastened to the ring in the floor, the table is immovable. Upon the completion of the operation the rope is gradually slackened, while an assistant pulls on the rope of the base of the table which is thus restored to the vertical position.

MEANS OF SECURING OTHER DOMESTIC ANIMALS.

(*a*) Bovines.—With these animals benignant measures are of little avail. Kindness may in some possible cases—but they will be rarely met with—succeed to a limited extent, but to trust to the influence of the treatment so often effective with an intelligent and docile equine, such as the petting caress, the soothing tone of voice, or the kindly glance of a human eye, with even the placid and mild-eyed milch kine, will be only an act of misplaced confidence. To blind them, to induce dizziness by turning them rapidly in a small circle, may at times produce good results, but even then these measures will be more reliable if combined with more palpable agents of restraint.

Cattle may be kept quiet in the standing position by raising their heads, by passing the index finger and thumb of one hand into the nostrils, with the arm over the face, and raising the tip of the head upward, while the other hand, grasping one of the horns, moves the top of the head downward, the resistance of the animal being overcome by pinching the nose with the hand which grasps it with more or less force. By this means the head of the animal is fixed, and the operator guarded against injury from the horns, and the movements more or less limited. While maintaining this position, the cavity of the mouth can be examined and even short and simple operations rapidly performed. Another device for preventing the animal from using his horns as a means

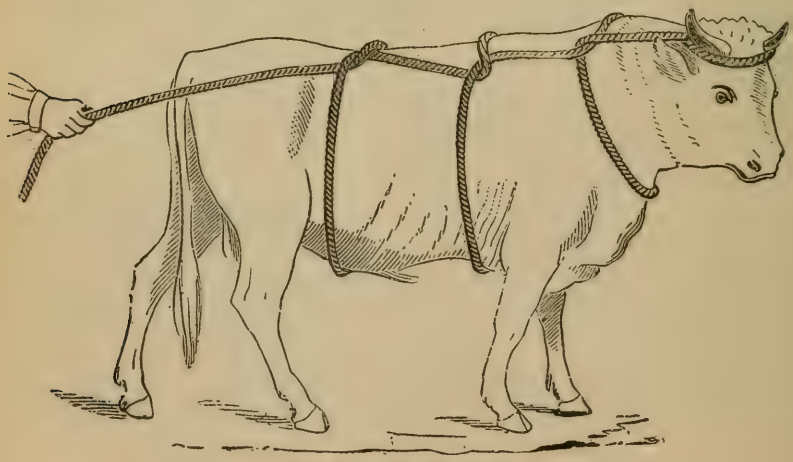


Fig. 41.—Securing Cattle.

of contention is to tie a long rope around their base, passing it along the neck and the back with one loop around the ribs and another further back around the flanks, and when reaching the tail securing it there by a knot at the base of that member. The head is thus kept elevated, and he is restrained from motion by the pain experienced by the tail when the rope is tightened by his attempt to flex it. This assures his passiveness (Fig. 42).

The practice of shielding the sharp points of the horns with smooth, metallic balls is one which tends largely to diminish the power of the animal for doing harm, by obviating to a great extent the danger from punctured wounds to which those who handle them are exposed. The best mode, however, of securing cattle while standing, is by tying the head up to a post or a tree, or again by yoking an individual with his mate or another animal of the same species. Kicks must also be guarded against. Those by the fore legs are avoided by raising one foot and tying it on the forearm, thus compelling the animal to stand on three legs. But the hind legs of cattle are the most dangerous from their ability to kick in so many directions, whether backward, forward or outward.

Several methods are recommended by which to guard against this form of danger. Among these may be mentioned the passing of the tail forward between the hind legs and then outward, carrying it towards the stifle of the leg from which the kick may proceed, and holding it firmly with a backward pull; thus surround-

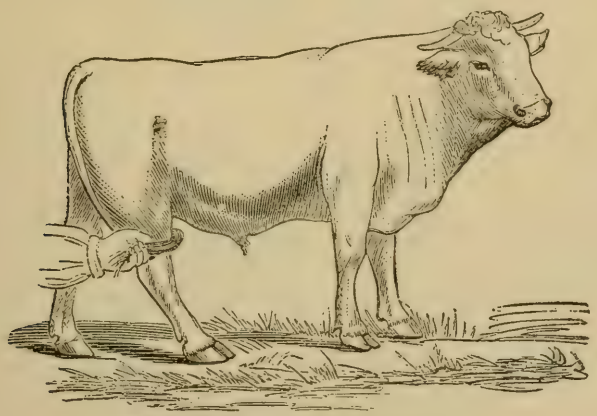


FIG. 42.—To Prevent Cattle from Kicking.

ing or tying the leg with the tail. Again, to pass a twitch round the leg above the hock, and to turn it until the tendo-Achilles pressed upon, is brought in contact with the posterior face of the leg. A loop of rope twisted upon a stick will answer the same purpose. The use of hobbles, single or double, or of the side lines to secure the hind legs, has also been recommended, as with solipeds, with the difference that the horns furnish a strong means of support, which is entirely lacking in the soliped. A method approved by some of controlling the motion of the animal is to pass a rope on one hind leg above the fetlock, and to carry this leg well forward, or even to raise it from the ground and to tie it by the rope to the forearm of the same side above the knee or around the horns. The use of a long bar of wood held under the abdomen by two assistants in front of the stifles; keeping the animal pressed against a wall by means of a wooden bar, with which an assistant pushes firmly against the stifle of the side opposite to that upon which the operator stands; binding the animal against a wall with a rope fixed to a ring in front of the chest and one behind the hind quarters—all these are simple means employed to keep cattle quiet in the standing position.

Some individuals, however, and especially bulls, are altogether intractable, and require more severe and effectual modes of punishment. These are applied upon the muzzle of the animal in his nasal septum by nippers or clamps, or with rings. Nippers are of divers forms. One true, single clamp is commonly used in Italy, and has been modified in England; another is in use in Hol-

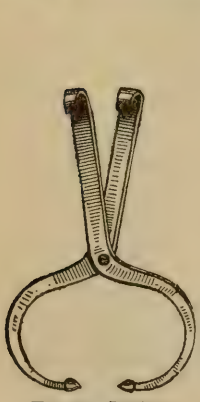


FIG. 43.—Italian Nose Clamp.

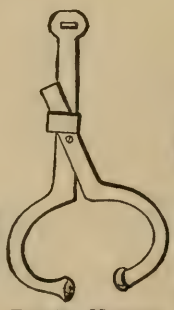
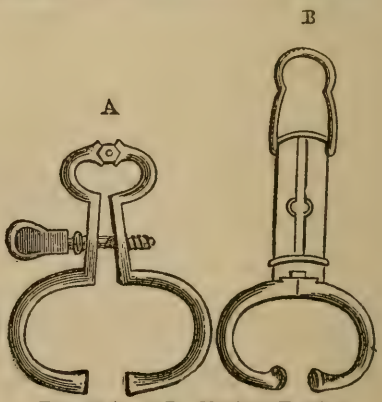


FIG. 44.—Modified English Nose Clamp



FIGS. 45 A and B.—Modified English Nose Clamps.

land, which is a true screw-clamp; another, which is preferred in France—are a few among the varieties of this single instrument for the application of pressure upon the septum nasi. They are generally secured on the front of the face by ropes or straps. They are effectual appliances, and by their aid the head can be kept up and the animal controlled without difficulty. Among the rings the simplest are most commonly in use. They are made in two parts, articulated at one extremity, and united at the other when in place by a rivet or screw. They vary much both in form and size. Some (though still known as *rings*) are square; others

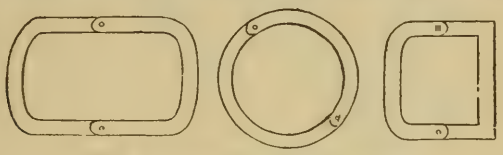


FIG. 46.—Square (?) Rings for Cattle,

are round and elliptical. The ring of Rolland, the Alsace ring, and some of simpler construction carry an auxiliary ring at some part of their circumference with which to secure them on the face of the animal by means of ropes or straps. These rings are applied after the perforation of the nasal septum with a trocar or a punch-nippers, making an opening of a size corresponding to that of the ring. Sometimes the perforation is made with a hot iron, the

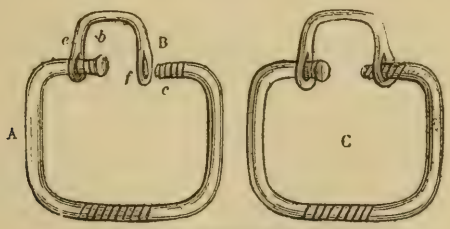


FIG. 47.—Ring of Rolland.

animal being properly secured and tied to a tree, or placed in a yoke with the head elevated, the operator making a quick puncture through the cartilage, and introducing the ring and riveting it. The hemorrhage soon ceases spontaneously.

In order to dispense with the punch, trocar, and the puncture with the hot iron, rings of a special construction have been invented. These also consist of two parts, and are also articulated,

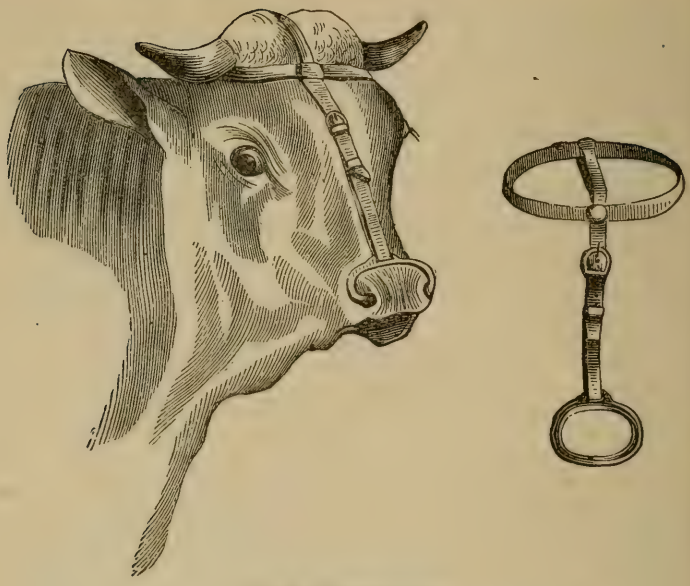


FIG. 48.—Alsatian Ring.

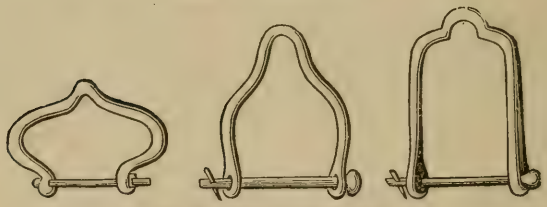


FIG. 49.—Rings with Eyelets.

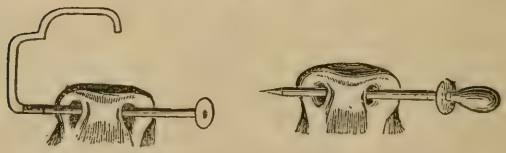


FIG. 50.—Puncture of the Septum with Trocars.

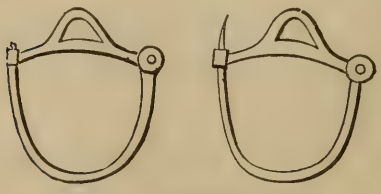


FIG. 51.—Rings with Points.

one of the joints having a sharp point with which the ring is pushed through the cartilage. A simple form represented in Figure 51 shows the point passing through an eye at the other extremity of the ring to be bent over it in order to close the instrument. The ring used in some parts of France is contrived

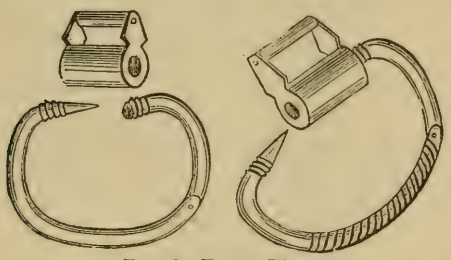


FIG. 52.—French Rings.

somewhat on the same plan, but is more complicated. That of Rueff is a kind of broken circle, which, when closed, forms a perfect ring in which the branches are kept together by a small screw.

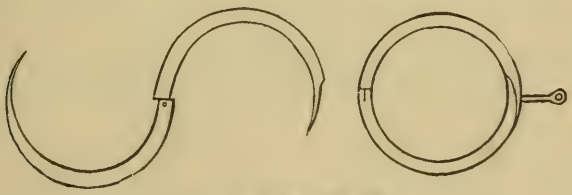


FIG. 53.—Ring of Rueff.

The rope which is attached to the nasal ring is not always sufficient to drive or control bulls, and conductor sticks armed at the end with iron hooks of various shapes are recommended. The apparatus of Vigan is a very simple one, but it fulfils all requirements and suffices for the restraint of the most vicious animals. It consists of a wooden pole with an iron prolongation having a wide ring by which to hold it, and at a short distance from this a hook to be inserted into the nose ring. Back of this is a strap to secure around the horns the bar over the top of the head as it passes between the horns. At the other extremity is an iron stifle through which a surcingle is passed to be tied around the body of the animal. Painful, and still easy to apply, this apparatus is not only a powerful means of restraint, but is sufficient to prevent any motion of the head.

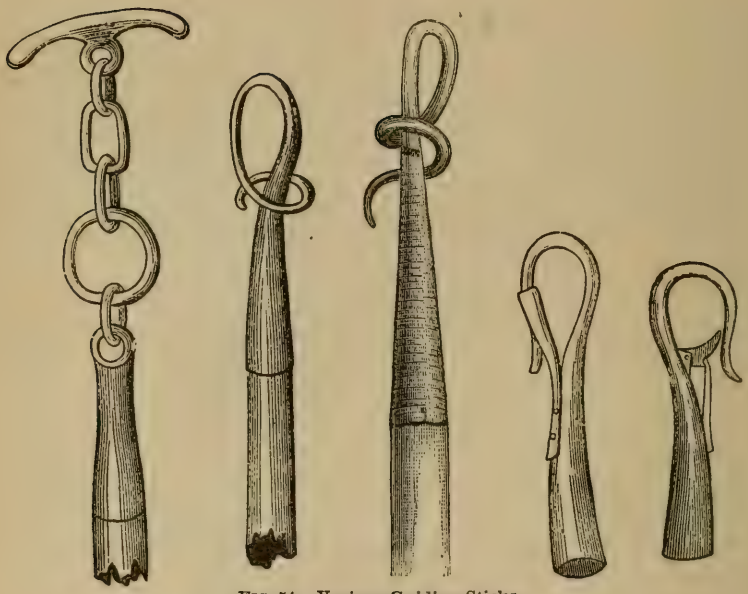


FIG. 54.—Various Guiding Sticks.

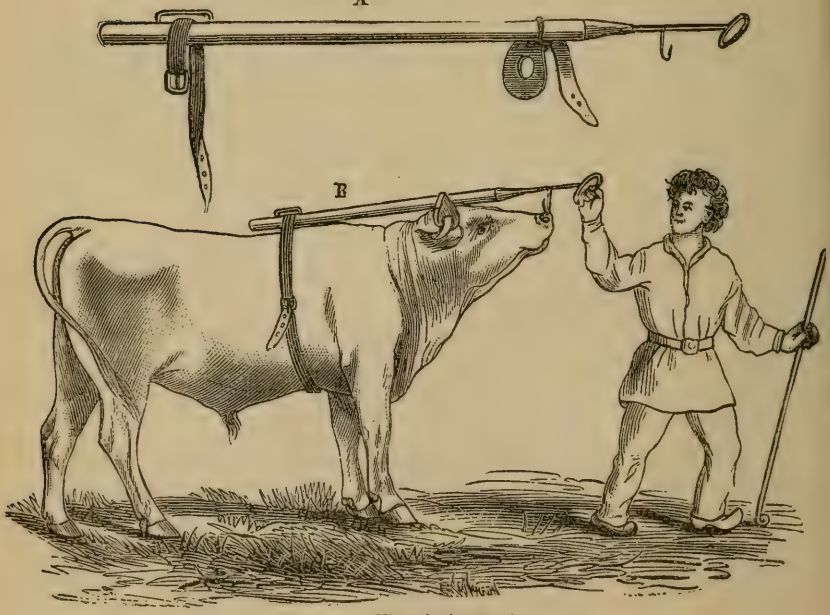


FIG. 55.—Vigan's Apparatus.

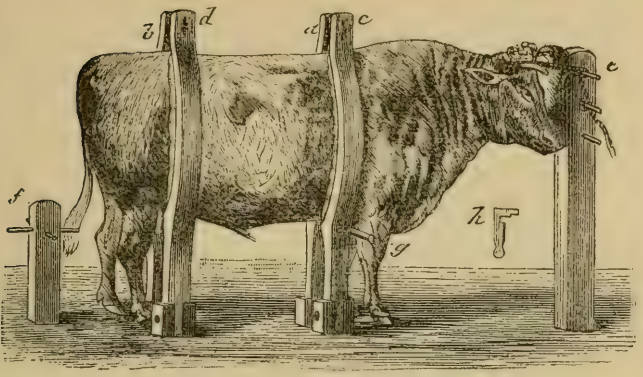


FIG. 56.—Steer Placed in Stock.

The use of stocks for the control of bovines is often also required. These are used principally in shoeing oxen, but are available for some operations which require greater passiveness than can be obtained by the applications of the simpler means above described. It is only in exceptional cases, and when an operation is likely to be unusually painful and prolonged, that the recumbent position is required with bovines.

The casting of cattle may be effected with or without hobbles, but in either case special care is necessary to provide a sufficiently thick bed to protect the head, and guard against the possible danger of fracturing the horns. A long board placed transversely across the neck, with an assistant seated on each end, affords an excellent means of controlling his efforts and struggles. When hobbles are used, they must be of smaller size than those used for horses, and should be placed above the fetlocks.

To cast bovines without hobbles, either of two methods, one invented by Rueff of Germany, and another described by Gwell and Hertwig, will answer the purpose. In the first, the Rueff method, a rope some thirty-six feet long is required, in the middle of which a loop is made and fixed round the base of the horns. The two free ends are then passed between the fore and the hind legs, each being twisted from within outwards, around one of the coronets, and brought back to the loop at the base of the horns, through which they are passed to assistants, one on each side, with directions to pull backwards. The feet are thus brought close together, and the animal seats himself on his hind quarters,

and finally stretches himself on the bed. If he struggles, the traction on the ropes only expedites the fall. If he pushes forward, or attempts to kick or even only moves his feet, the running of the rope is so much more facilitated.

In the other mode, a rope about the same length and carrying in one extremity a loop which is thrown over the horns, is passed backwards along the superior border of the neck, as far as about its middle, where a loose loop is made; then carried backwards at the side of the vertebral column, where another loop is made, behind the shoulders, and a third one around the abdomen, on a level with the flank, where an assistant holds it backwards by the side of the sacrum. If the animal is to be thrown on the left side, the rope must pass on the right of the base of the tail, and *vice versa*. Two assistants pull on the rope, while another holds the head and tries to bring the animal down. The traction on the ropes tightens the three loops, and under the effect of this force the animal is made to lie down quietly. It facilitates the operation to lubricate the rope with a little grease or soap.

In order to avoid complications from lacing the ropes too tightly about the body, it is always indicated to subject the patient to a moderate fast previous to casting by this mode.

(*b*) Ovines and Caprines.—Although these animals are timid and comparatively lacking in strength, they are at times capable of struggling violently and becoming dangerous, and they cannot be subjected to surgical treatment without being cast. This is done by grasping both legs of one lateral biped, the right fore and hind legs, for instance, and laying him over on the opposite side, the left, and *vice versa*. If all the legs are to be secured, those of each lateral biped are first tied, and with the two cords a straight knot is made, binding all together.

If the seat of operation is the head, the animal is held by an assistant, who sits with the body of the animal between his legs, with its back close to his own body, holding the fore legs with his hands, and controlling the hind quarters between his legs. In some cases when the operation is light, the operator holds the animal himself without help.

(*c*) Swine.—Securing a good hold of this animal is not always an easy task, and it sometimes requires not a little skill and cunning to do so. When seized, two assistants are necessary to cast him, especially if he is of large size, and when down, either a muz-

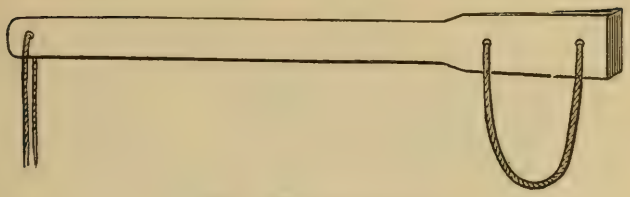


FIG. 57.—Twitch for Swine.

zle must be put on his snout to prevent his biting, or a peculiar twitch placed between his jaws and twisted over the upper one.

If an examination or operation is to be made about the mouth, a wooden gag placed between the jaws and held with cords, will be found of great utility. The various operations performed upon

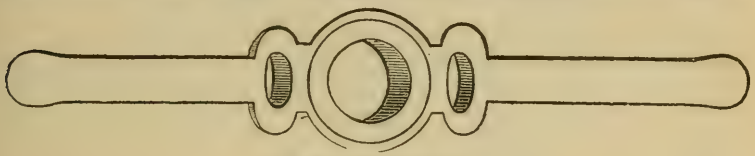


FIG. 58.—Gag for Swine.

the noses of swine, to prevent them from digging the ground, may be considered to some extent as means of restraint. The incision of the snout, which consists in making several transverse cuts through it; the nasal tenotomy, though not so successful; the application of rings through the nose, by the same methods as

FIG. 59.—To Prevent Swine from Digging.

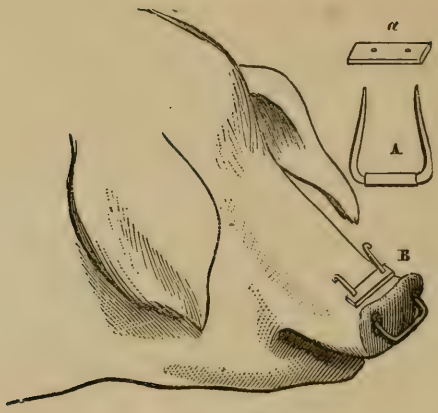


FIG. 59*a*.—Another Mode.

those used in cattle, are simple means which only need mention, being more frequently performed in fact by raisers and breeders of swine, and indeed rather belonging to their special domain than to that of the professional veterinarian.

FIG. 60.—To Prevent Dogs from Biting.

(*d*) DOGS AND CATS.—Dogs can be prevented from biting by muzzling them, or with a cord or band wrapped first around the lower jaw, and then around both, and secured over the neck behind the ears.

To examine the mouth in the absence of a speculum, as the one represented in Figure 61, the mouth may be held open by cords passed around each jaw behind their tusks, and pulling them apart. If the animal is dangerous or ugly, the collar nippers

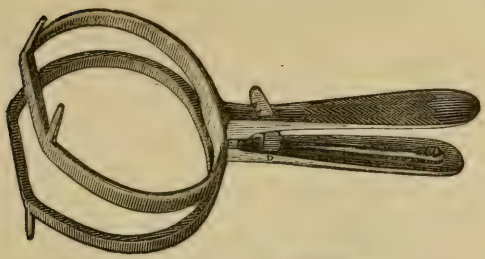


FIG. 61.—Mouth Speculum for Dogs.

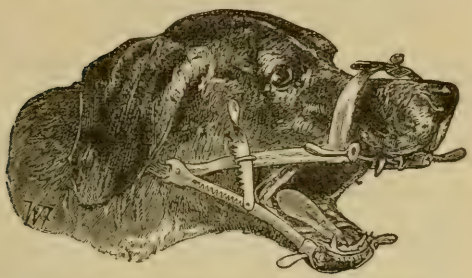


FIG. 62.—Keeping the Mouth of a Dog Open.

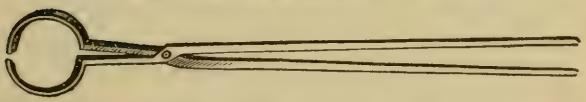


FIG. 63.—Collar Nippers for Dogs.

become very handy, in order to hold them by the neck and keep them under control, whether for operation or for administration of medicines.

Cats are most difficult to handle. They bite and they scratch, and they are often unconquerable until they are fully subjected to general anesthesia. In many instances, the co-operation of a good assistant, accustomed to handling them, may be found necessary. They may sometimes be made amenable to treatment by grasping them by the neck behind the ears, and close to the head with one hand, and securing the fore paws with the other, while a second assistant holds the hind legs, or it may become necessary to have the four paws tied tightly together, and only the head held by the assistant.

We have heard of the utilization of a man's boot as a means of feline restraint, particularly in the castration of the male, or "Tom," the head and body of the animal being thrust into the leg

of the garment, leaving only the posterior portions exposed and accessible to the operator. This may not be a scientific device, but its effectiveness can hardly be doubted.

SURGICAL ANESTHESIA.

A resort to the various means of restraint, which we have been considering, is sufficient in a majority of cases to bring under perfect control such animals as require to be subjected to surgical treatment. But there is a class of cases in which they become inadequate to meet the great requirements of inducing in the patient a condition in which a great diminution, or the entire suspension, of sensibility and consciousness, with all power of muscular reaction, is established throughout the organism. This result is obtained through the characteristic action of the special therapeutical compounds, known as anesthesia.

It is not merely as a more effectual means of securing control over refractory patients that their administration is justified. It is also prompted by a proper humanitarian feeling in cases in which severe and prolonged suffering accompany the operation.

In veterinary surgery, the indication for anesthesia, has not, to the same extent as in human, the avoidance of pain in the patient for its object, and though the duties of the veterinarian include that of avoiding the infliction of *unnecessary* pain as much as possible, the administration of anesthetic compounds aims principally to facilitate the performance of the operation for its own sake, by depriving the patient of the power of obstructing, and perhaps even frustrating its execution, to his own detriment, by the violence of his struggles, and the persistency of his resistance. To prevent these, with their disastrous consequences, is the prime motive in the induction of the anesthetic state. That it perfectly succeeds in fixing the patient in the attitude most favorable for the surgeon in the execution of the various parts of his task, needs no affirmation, nor need we attempt to measure the value of the discovery, which has proved itself to be such a priceless benefaction to the world.

There are special cases where anesthesia is more particularly necessary than in others, and where absolute immobility of the patient is essential, and entire muscular relaxation indispensable. Thus it is indicated in the reduction of fractures or dislocations in

the large domestic animals; in cases of delicate manipulation and dissection with sharp instruments, as in the operation for strangulated inguinal hernia; in the reduction of other hernial tumors, in the performance of neurotomy; in operations upon the eye, and in the removal of tumors of certain kinds. It is also indicated in certain operations upon the foot, which are always accompanied with great pain, such as that for the extirpation of a portion of the quarter of the foot, in the removal of the cartilage affected with necrosis (quittor); or again, in deep punctured wounds of the sole, where the resection of the plantar aponcurosis becomes necessary, or the bones are scraped with the knife.

The anesthetic condition is also very favorable for the reduction of displaced organs, as of a prolapsed rectum, or uterus, or bladder.

In operations upon the teeth, in some cases of parturition, in castration, in firing, or even in the application of hobbles, the induction of the anesthetic state has often been of great benefit in quieting nervous animals, and subduing them to a condition of passiveness, which relieved the movements of the surgeon from all embarrassment and uncertainty.

As with human patients, anesthetics are contra-indicated in animals subject to diseases of the heart or of the lungs. A full stomach is also always a contra-indication of their administration, especially in solipeds, which are lacking in the ability to relieve it of its contents by vomiting.

Anesthesia may be either *local* or *general*, according to the area of its effects. *Local*, when applied to the skin over a limited surface, to which its effects are confined; and *general*, when administered by inhalation, and through the respiratory organs influencing the entire economy.

In local anesthesia the effects are obtained either by the pulverization of the proper substance upon the region where it is required to take effect, or by the subcutaneous injection of special agents. General anesthesia is usually produced by the inhalation of the vapors of ether or of chloroform.

LOCAL ANESTHESIA.

The special indications for this are so numerous that they may almost be considered as general, if not universal, and its application is so simple and easy a process, and its effects usually so cer-

tain, that it would become the practitioners of our day to utilize it more frequently and extensively than they do. It is available as well as useful in the simplest operations, and may be employed in the opening of abscesses and cysts; in the puncture of cold abscesses with the hot irons; in the puncture of the cornea; in neurotomy; in simple incisions of the skin; in the removal of small tumors, etc., etc. We have used it with the best results in urethrotomy, in caudal myotomy, in amputation of the tail, and the removal of mammary tumors in dogs, etc. Bouley long ago recommended its application to surgical diagnosis, in cases of doubtful lameness, an expedient which has recently been introduced into this country by several veterinarians, for the differential diagnosis of shoulder and foot lameness.

We have remarked that the anesthesia can be produced in several ways, though two are principally in use. Among these properly termed minor and secondary expedients, are the application of cold water or ice, and cooling or freezing mixtures, and pressure upon the blood-vessels and nerves, which have for years been among the adjunct and agencies of surgical practice, but have given place in recent times to methods more potent and more certain in their effects. Notwithstanding this, however. some mention of their nature and qualities, and the methods of utilizing them will not be out of place, if only as a matter of general reference, and a case might arise in practice when the information might become practically valuable.

1st. *Pulverization of an Anesthetic Liquid.*—The apparatus employed for this process is the invention of Dr. Richardson, and though the spraying tube has been from time to time more or

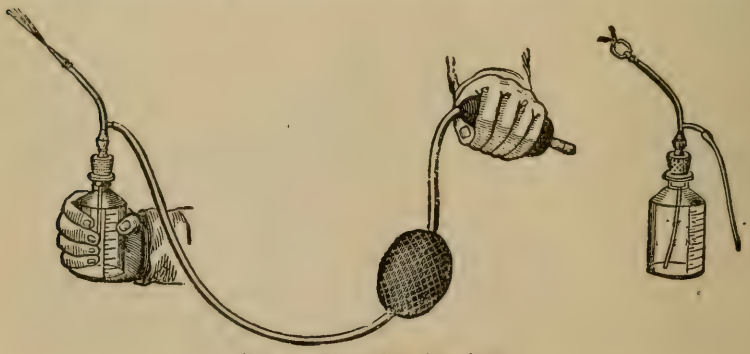


FIG. 64.—Richardson Atomizer.

less modified, the mode of its employment continues unchanged; though any substance susceptible of easy pulverization may be employed. Ether is the agent most frequently chosen. Rigolene has given us great satisfaction in our own practice.

In impinging upon the skin in a state of excessive division, the rapid evaporation of the liquid lowers the temperature of the surface with which it comes in contact, and it is this process of refrigeration which diminishes the local sensibility, and, as the effect increases, overcomes it entirely for the time being, or so long as the spray continues to be thrown upon the part.

Some slight objections, however, may be alleged against this mode of producing insensibility, arising from the special properties of the fluid employed, and for this reason the mode by subcutaneous injection is somewhat to be preferred.

2d. *Subcutaneous Injections.*—Both ether and chloroform have been recommended, and extensively used, in this manner, but without doubt the salts or compounds of cocaine possess ad-

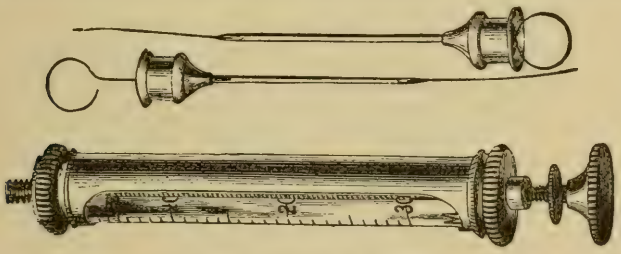


FIG. 65.—Syringe of Pravaz.

vantages over either of them. An epidermic syringe, or that of Pravaz, is generally used for the purpose, with a solution of from four to twenty per cent. strength, according to circumstances.

If used on a tumor a certain quantity of the solution, perhaps twenty drops, is injected under the skin at two or three points around its circumference, the desired effect following, and the parts being ready for the operation within from eight to ten minutes, more or less, according to the strength of the dose administered. Either of these modes of local anesthesia is harmless, and may be employed without risk or fear of complications.

GENERAL ANESTHESIA.

The three principal agents which recommend themselves by the efficiency and certainty of their action in producing general anesthesia, are ether, chloroform and chloral hydrate. Their adaptation varies, however, with the animals subjected to their administration. Chloroform and chloral are chiefly used for the larger animals, principally horses, while chloral and ether are reserved for the smaller kinds, with which chloroform is so generally dangerous, and even so often fatal, that its use with them is almost entirely discarded.

Insensibility by Anesthetic Vapors.—The modes adopted for the inhalation of the vapors of chloroform are numerous, but among them all the merit of simplicity should probably be awarded to that which is recommended by Bouley. This consists in the introduction into each nostril of a small sponge, or a ball of oakum, saturated with the ether or chloroform, and held in place by the hands of assistants. The inhalation of the vapors, which are thus mixed with air, proceeds rapidly, the sponges being recharged as soon as they become exhausted, and returned to the nostril, until the object in view is accomplished. But while this mode is a very convenient one, we conceive it to be liable to certain objections.

First, unless the pouring of the liquid is very carefully performed and in such quantity that the sponge is not over-saturated, there is danger that a large portion of it may be wasted, by running off, either on the bed, or possibly, into the nostrils, causing, in the latter case, great irritation of the mucous membrane. And if the anesthesia is to be continued for a considerable length of time, the effect produced upon the delicate membrane of the nose may be sufficiently serious to end in the sloughing of the parts. It must certainly have been with the view of avoiding this complication that Defays invented the inhaler shown in figure 66 with its wide range of application, from the dog to the horse.

Many veterinarians have adopted an arrangement consisting of a strong leather muzzle with large openings at its bottom and sides for the free admission of the atmospheric air, the sponge or oakum charged with the chloroform or ether being placed in the bottom of the muzzle, which is fixed upon the animal's head in the

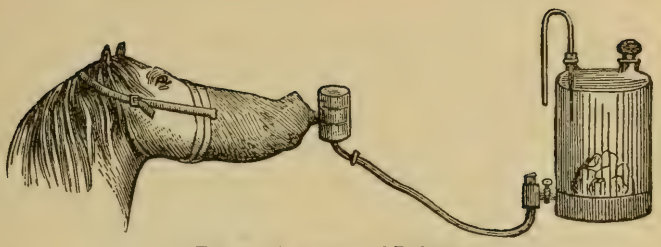


FIG. 66.—Apparatus of Defays.

ordinary way. This is a very convenient, though quite a simple contrivance, but English veterinarians, and among them Mr. R. Cox, recommend in preference a chloroform-bag, in the form of an ordinary bag, made of strong canvas, both ends of which can be closed by a running string, one being tied around the nose

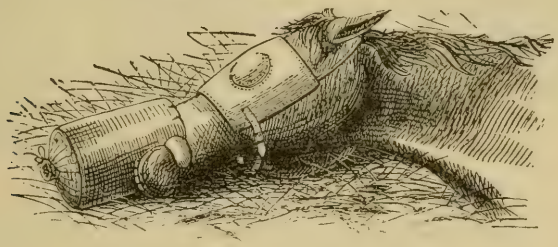


FIG. 67.—Cox's Chloroform Bag in Position.

while the bag is secured by cords to the halter or to the straps of the cap. The chloroform is introduced into the bag by means of a thin piece of cloth saturated with the liquid.

The chloroform nose-cap recommended by Mr. Gresswell also answers a very good purpose, and in fact, possesses advantages which render it superior to the apparatus of Mr. Cox. It is not so portable in its form, but is more durable in its construction. In fact, it produces the features of the ordinary stable muzzle which we have already mentioned.

The apparatus of Carlisle is also one of English invention, for which great merit is claimed. We have used it, and the trial has shown it to possess many features of marked superiority over the others.

The quantity of liquid required to bring a large animal under complete general anesthesia cannot be positively ascertained.

FIG. 68.—Gresswell's Chloroform Nose-Bag.

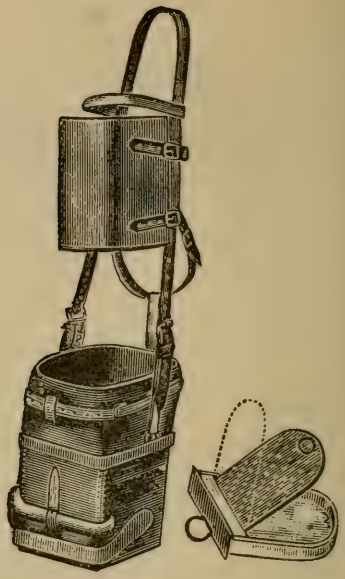


FIG. 69.—Carlisle's Chloroform Inhaler.

While it has often been induced by the inhalation of a single ounce, there are cases in which two, three, or even more have been necessary. An essential point to consider is that the chloroform should be absolutely pure. Mixtures of two or more drugs have also been employed, usually ether and chloroform, with or without the addition of alcohol, but the result of all experimental tests has been, with us, to establish the conviction, that as yet, chloroform used singly has proved itself to be the most effective and the safest of all. The administration of chloroform of course pre-supposes, besides all the other conditions and preliminaries of an operation, such as previous fasting, the preparation of the bed, and other incidental steps, the act of throwing the patient.

When the effects of the inhalations begin to become manifest, the first physiological change noticed is an extreme agitation, accompanied with coughing. The animal struggles more or less violently, the irritation and tickling of the throat produced by the vapors upon the laryngeal mucous membrane, giving rise to a spasmodic motion of the glottis, and whether the patient be a

large or a small animal, he exerts his strength to rid himself of the apparatus and regain his freedom of motion.

These manifestations are, however, but of short duration, and are soon followed by a state of passiveness, the respiration becoming easier, the cough disappearing and his energy subsiding; and in short, he is subdued. The eye then assumes its characteristic expression, its brilliancy is lost, it is wide open, the pupils slowly dilate, the gaze becomes fixed, the sensibility of the cornea is lost, and the light ceases to effect it. The mouth becomes more or less loaded with saliva; the pulse, which must be carefully noted by an assistant, becomes slow and weak, the respiration returns to its normal condition; the state of complete anesthesia has been reached, and the patient, in happy unconsciousness, is ready for the surgeon.

The time required to reach this condition varies with the subject, and especially with the quality of the drug administered. The average period is from one to five minutes in small animals, and from ten to fifteen in the large. In some few cases, however, half an hour may elapse before complete insensibility is produced, and again animals are encountered with peculiar idiosyncrasies, which remain entirely refractory, and successfully resist every attempt to reduce them to insensibility; a statement equally true when applied to human patients.

The duration of the Anesthesia.—Some animals remaining under the influence only for a few minutes, sometimes from fifteen to thirty or forty, it becomes necessary to prolong the insensibility by renewing the inhalation, and they must, therefore, be continued until the completion of the operation. Recovery from the anesthetic state does not always take place immediately and perfectly. As the effect begins to subside, the animal, having partially regained his senses, begins to move his eyes, raises his head, perhaps allows it to fall back slowly on the bed, lying flat on his broadside; then his legs begin to move, and presently he attempts to spring suddenly to his feet. He may succeed in doing so, but again, his muscles may not have yet recuperated their power of full action, and there may be danger of his experiencing a heavy fall on the bed. His condition is one of drunkenness, and he requires to be watched, and, if necessary, aided, in order to prevent him from injuring himself by efforts beyond his strength while in a state of weakness of which he is unaware.

The symptoms of general anesthesia by chloroform, which we have detailed, are those of ordinary cases. There are, however, other symptoms which the vigilant operator will not fail to look for, which are of great importance as indicative of the dangers, and premonitory of some of the casualties incident to the situation. These we reserve for subsequent consideration.

Anesthesia by the Administration of Chloral.—While this drug and its compounds, as sometimes used, produces in some cases a condition of insensibility quite as complete as that obtained by chloroform or ether, yet there are cases in which only a less complete degree of success can be secured, though still sufficient to be of great assistance to the surgeon as well as of relief to the patient. That the intra-venous injection of chloral has been shown to be the best of all modes of obtaining anesthesia, is an admitted truth, but unfortunately it is a method of introducing it into the system which will scarcely ever become sufficiently practicable to be available outside of the laboratory. Efforts to overcome the difficulty referred to have not been wanting, however, and Messrs. Cadeac and Mallet have experimented with chloral by combining its action with that of muriate of morphine. By first injecting subcutaneously a certain quantity of a solution of morphine, and following it after a few minutes by a rectal injection of a solution of chloral, they have obtained complete anesthesia in a very short time. For a horse they have used eighty centigrammes to one gramme of the morphine, and from eighty to one hundred grammes of chloral; and, for a dog, ten centigrammes of morphine and twenty grammes of chloral

The administration of chloral in the form of balls, as commonly practised by many veterinarians, in doses varying from one to one and a half ounces, given on an empty stomach, and from one to two hours before the operation, is undoubtedly good practice. We have not personally had the opportunity of testing it in cases of long and tedious dissections, but the benefit we have often derived from it in short, though painful operations, justifies us in recommending it, not only for this very object, but in any case, where, from any possible cause, an animal is likely to receive severe injuries during his struggles to liberate himself.

ACCIDENTS OF GENERAL ANESTHESIA.

Notwithstanding the caution observed in the use of ether or chloroform, and however pure these articles may be, accidents must be expected during their administration. They are not always of a serious nature, but they may at times have fatal results. Among those of minor importance is the *cough* which becomes at times quite troublesome, but may be readily subdued by a temporary arrest of the inhalation; *vomiting*, which often occurs in small animals, but which can be guarded against by causing the patient to fast long enough to insure an empty stomach before being etherized, and *spasmodic contractions*, of which the existence, when undoubtedly present, is often overlooked. Among those of more serious nature are *syncope*, either *cardiac* or *respiratory*.

Cardiac syncope is a very serious accident, and in a majority of cases proves fatal, especially in large animals. It is sudden in its manifestation, and often unobserved until at too late a period of the operation. It is due to a gradual diminution, followed by an arrest of the muscular contractions of the heart, and as far as our observation extends is always associated with pre-existing heart disease. The application of cold douches, of heart stimulants, ammonia given by inhalation or internally, are the first indications in these cases.

Respiratory syncope, which is far less dangerous, arises from the influence of the laryngeal nerves upon the activity of the respiratory centers. Its access is sudden, being caused by the arrest of the respiration. There is no convulsion, though the intoxication produced by the anesthetic vapors is sudden in its effects, and is generally detected only by careful watching.

The application of electricity, that of the electro-puncture, and especially persevering efforts to effect artificial respiration, may sometimes save the animal, provided the trouble is not connected with the complete arrest of the contractions of the heart.

In view of these possible incidental conditions, some general rules suggest themselves tending to their avoidance. Great care and exactness in gauging the doses of the anesthesia, with such caution in their administration as to produce a slow and graduated effect, is one point. Free allowance for the introduction of air with the vapors inhaled; close attention to the state of the

circulatory and respiratory apparatuses, and the manner in which their functions are executed, by noticing the heart-beat and watching the pulse and the movements of respiration at the flanks, are other points of importance.

Another point is the need of bearing in mind that an animal submitted several days in succession to general anesthesia becomes more and more susceptible to its effects, and therefore more exposed to the dangers they imply.

ACCIDENTS INCIDENTAL TO THE USE OF MEANS OF RESTRAINT.

We have already considered some of the accidents which are likely to interfere with the successful application of the means of restraint, and especially with reference to the final act of the preliminary series which occur at the moment of throwing the animal and depositing him on his bed, particularly such as may follow the neglect of properly protecting the head with the cap or blinkers, or by an unnecessarily prolonged use of the twitch, or from the sudden and violent movements of the animal himself. These can usually be obviated by proper forethought and watchfulness. But the most careful attention cannot always assure immunity from miscarriage and casualties. Thus, a common mishap, and one which cannot be anticipated nor prevented, is the sudden and heavy fall of the animal just as his equilibrium is lost. The lesions which may follow this casualty may have their seat either in the hard or soft structures, and are of the most serious character, not only including, at times, fractures and dislocations, and lacerations of the soft tissues, including the muscles, but may affect the viscera, and even the blood vessels and the nerves—in this last case involving the parts in all the evils of local paralysis and its disabilities.

(*a*) Fractures.

This form of injury may have its seat in the vertebral column, the ribs, and the bones of the extremities.

1st. *Fractures of the Vertebral Column.*—In the list of fractures, those of this region of the body are the most frequent. The numerous reports of cases which are made public by veterinary writers furnish sufficient evidence of the facility and frequency of their occurrence, even when the most careful attention has been

bestowed on all the details of the work of casting. The very peculiar circumstances under which these spinal fractures sometimes take place, baffling calculation, and occurring when least expected or prepared for, illustrate the responsibility which the veterinarian assumes, and the culpability with which he would become chargeable by undertaking the work without due caution and preparation, or without notifying the owner of the animal of all the hazards and difficulties attending the case in all its steps and stages. As will be seen when we come to the consideration of this special lesion in the chapter on fractures, the symptoms which accompany this accident are distinguished, as to one feature, by the suddenness of their appearance, which takes place at the moment of the infliction of the injury or immediately after. But the most important of the characteristics of the case is the grave fact that the fracture is almost always of the comminuted kind. This is held to be due to the excessively powerful muscular contraction, resulting in the over-arching of the vertebral column simultaneously with pressure from the abdominal organs, caused by the sudden extension of the anterior and posterior bipeds, bound together with hobbles, the violence of the struggle so powerfully pressing the vertebræ together as to result in the yielding of their spongy structure; and the crushing or grinding of the bone is the consequence.

This theory of the production of fractures of this character has been adopted by the majority of European veterinarians, especially by those of France, where it is understood as "Bouley's Classical Theory." In 1889, however, another theory was propounded and defended by Mr. Moussel, of Alfort, differing entirely from that of Bouley, in which he claims that the kind of fracture in question is not caused by an *over flexion* of the spine, but, on the contrary, is the effect of an *excessive extension!* resulting from greater contraction of the ilio-spinalis muscle.

According to Dickerhoft, "three factors are active in the causation of these fractures. In the first place, the animal must have some object as a *point d' appui* for one hind leg; that point must be connected with either one of the other extremities or directly with the trunk. * * * Secondly, the horse must make his vertebral column tense by the contraction of the spinal extensor muscles. * * * Thirdly, the horse must, simultaneously with the extension of the hind leg and that of the vertebral column, draw its pelvis

to one side. * * * But no one of these three elements, in itself, will produce a fracture; they must all concur."

Whatever may be the value of these theories, the fact that at post-mortem examinations fractures have been discovered, in some cases in the annular portion, and in others in the body, seems to prove that any one of them is equally applicable with another.

To prevent these fractures, therefore, becomes the principal object of the surgeon at the critical moment when the animal is thrown. This involves a strict attention to the rules which we have laid down for his guidance in the various steps of the act of casting; and, moreover, to have recourse, as often as possible and as the indications suggest, to the aid of anesthetic agencies, and by no means to ignore the value or neglect the use of the apparatus of Bernardot & Buttel.

2d. *Fractures of the Ribs.*—These fractures are undoubtedly frequent, as the result of heavy falls upon a badly-made bed—too hard or too thin, or perhaps concealing hard substances, as stones or the like.

3d. *Fractures of the Pelvic Bones.*—There are but few cases on record of this kind of injury, but they are possible, as the result of carelessness in the preparation of the bed or improper casting, or powerful muscular contraction.

4th. *Fractures of the Bones of the Extremities.*—Though probably less common than those last referred to, these lesions are not unknown in veterinary practice. They occur principally in the diaphyses of bones, or near to, or at the epiphysis, and are often incomplete in their nature. Delafond describes a case of fracture of the femur taking place during the application of the clamps while undergoing the operation of castration; and another case is recorded of which the trochanter of the femur was the seat. Rey has reported a case of fracture of the cubitus taking place as the animal, when freed from the hobbles, made a violent effort to spring from the bed upon which he had been thrown to be fired for a chronic enlargement. These fractures of the extremities may be avoided by careful attention, not only at the time of throwing the patient, but in placing him in position and in properly securing him, and giving him judicious assistance in regaining his feet.

5th. *Dislocations.*—These accidents are of very rare occurrence. One case, however, is recorded of a dislocation backwards of the humerus, complicated with fracture of the cubitus.

(*b*) INJURIES TO SOFT TISSUES.

1st. *Lacerations of Muscles and their Annexes.*—These are the result of the distorted positions into which the extremities are forced while undergoing operations. They may be discovered immediately, or may be developed a few days after the operation. Inflammation of the olecranean and pectoral muscles, of those of the croup, and of the anterior part of the shoulder have been reported. Bouley has seen a rupture of the aponeurosis of the great and of the small oblique muscle of the abdomen, and one rupture of the flexor metatarsi. A case of laceration of the diaphragm is recorded by Bouley, Jr. In one of our own patients, laceration of the olecranean muscles was followed by such severe complications, that it became necessary to destroy the patient.

2d. *Ruptures of the Viscera.*—These are of rare occurrence, being generally prevented by the precaution of refraining from throwing the animal, until assured of an empty digestive canal by previous fasting. Accidents, however, have been witnessed by Gohier, who has noticed their occurrence upon the rectum near the anus. This horse had drunk freely of water before being cast. Bouley, Jr., has seen a case of rupture of the diaphragm. Rey has known one of the heart, Schaak one of laceration of the humeral artery, and even the giving way of the vena cava, in a case of a nervous animal upon which means of restraint were being applied to dress a small wound. The patient suddenly fell, and, struggling violently, died; and at the post-mortem the abdomen was found full of blood, and the vein torn back of the kidneys

3d. *Injuries to Nerves.*—These are accompanied with loss of power, usually temporary, but sometimes permanent. The position in which it is sometimes necessary to fix an animal, as in the diagonal, is that in which they are most likely to occur. The symptoms of paralysis which are then manifested, betray themselves when the animal has just risen from the bed, when, upon being called upon to move, the leg is discovered to be unable to carry its weight, flexing upon its various bony levers, and rendering locomotion impossible. Sometimes these symptoms are of but short continuance, and disappear under the influence of strong stimulating frictions. The leg was, according to the popular phrase, "asleep," because of a temporary arrest and sluggishness of the circulation. But in other cases, the condition is brought

on by a true lesion of the nerves, the brachial, the lumbar plexus, or some of their branches having undergone some traumatic hurt which may prove more or less refractory to treatment.

4th. *Asphyxia.*—According to Peuch and Toussaint, this accident may result from the ignorance of assistants, who, in controlling the animal and keeping him down on the bed, have compressed the nostrils too tightly; or again it may be caused by the excessive pressure of the throat straps of the halter, or of the rope which encircles the neck when a horse is placed in position for castration. To explain the causes of this accident should be, with an intelligent operator, sufficiently to hint the means of preventing its occurrence.

Conclusions.—A review of the matters we have been considering in this chapter may not be out of place, nor unprofitable, even at the risk of being, perhaps, a little repetitious. In view of the occurrence of these accidents, and appreciating the responsibility assumed by the surgeon when about performing an operation upon a more or less valuable animal, he cannot but be conscious of the obligations which impose themselves upon him to take every precaution to avoid them. He should therefore guard against their eventual contingency, by closely inquiring concerning the condition of his patient, and by satisfying himself that every part of the apparatus of restraint is in good order; should avoid rough treatment and employ anesthesia when possible, and never put an animal in a constrained position for treatment when an operation can be otherwise performed more advantageously and easily and comfortably to his patient, and he should never allow him to remain in his restrained and compulsory recumbent position longer than is strictly necessary. And above all, he should never undertake an operation without having fully acquainted the owner of the animal of the possibility of accidents. The fact of thus explaining matters to an owner, and of obtaining his intelligent consent does not, of course, relieve the surgeon of his responsibility, but rather, on the contrary, confirms and increases it by thus adding a new, though an implied pledge to his employer to devote his most conscientious endeavors and exercise his best skill in the matter, in token of his appreciation of the confidence placed in his skill and faithfulness.

CHAPTER II.

SURGICAL DIAGNOSIS.

The first query to be settled in examining a diseased animal is whether the ailment with which he is attacked is merely a case of disordered function, requiring only the administration of the proper drugs to restore the usual order of things, or a case demanding the operative skill and expert ministrations of the surgeon, with bistoury and cautery and suture. The decision of this query involves a thorough knowledge of anatomy, and is comparatively more difficult, as well as more important, than the mere medical diagnosis of diseases pertaining to internal pathology. Errors in surgical diagnosis are always both more dangerous and more important than those of a mere medical character, inasmuch as they are likely to be more readily exposed, and to involve a greater amount of responsibility on the part of the surgeon.

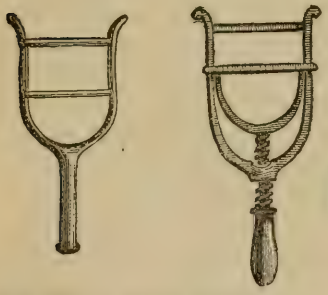
To insure the certainty of his diagnosis, the surgeon must call into exercise all his resources of knowledge and experience, and employ all his faculties of observation and discrimination, with such instrumental aid as may serve to facilitate and confirm his conclusion, as to the nature of the cases before him. He must especially employ all his organs of sense in the investigation. A single sense is sometimes sufficient to diagnosticate the character of some special lesions, but more commonly each sense is an auxiliary of the others, and all are complementary to each. In fact, the surgeon is not justified in reaching a conclusion as to the detection of an affection, which is discovered by the sight, or touch, or smell, or hearing, alone, but to escape the possibility of error, he is bound to confirm his discovery by the corroboration of another, or what is still better, of all the others, if possible. In these cases, as in others, the eye is the most valuable and comprehensible of the organs.

1st. *Sight.*—Visible changes of contour, or color, or other deviations from the usual appearance of tissues, or of regions, are of course first made known through the sight of the eye. Deformities, unless of very minute dimensions, with abnormal

growths, prominent swellings and changes of direction in the bony levers, belong to the same category, and if these are not sufficiently distinct or conspicuous, and seem likely to escape the visual observation of the surgeon, a careful measurement may decide the point. The eye must also discern the changes occurring in the various visible membranes, as for example, the heightened redness of a congested membrane, and the paleness of an anæmic subject.

Again, if there is abnormal motion in a part, as in fractures and dislocations, it is to the eye that the disclosure is first made. This application and study of the use of his eye will be very serviceable to the surgeon in the examination of the external surface of the body, but when examinations within the organism, or within its cavity, become necessary, however strong a light he may have at his disposal, he will be compelled to have recourse for assistance to the speculum, to hold the parts open. There are many forms of this instrument.

The speculum oris, for the mouth, has very numerous shapes, some of them very simple, as in Figures 70 and 71, and some com-



FIGS. 70 & 71.—Simple Speculum Oris.

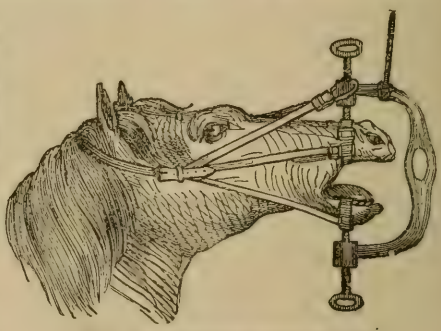


FIG. 72.—Brogniez Speculum Oris.

plicated, as in Fig. 72, the speculum of Brogniez. Green's speculum is an American invention, simple, safe, comfortable to the patient, and of easy manipulation (Fig. 73). Grange's mouth speculum is rather clumsy and heavy (Fig. 74). These instruments are generally employed for solipeds. Placed between the jaws, they open the mouth forcibly, and keep it so as long as they continue in place.

Sometimes, however, the mouths of these animals, as well as those of ruminants, can be held open without them, by putting

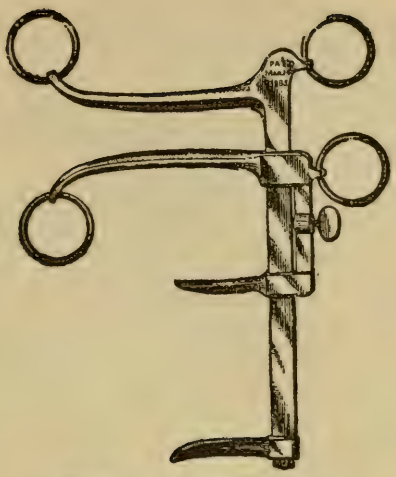


FIG. 73.—Green's Speculum Oris.

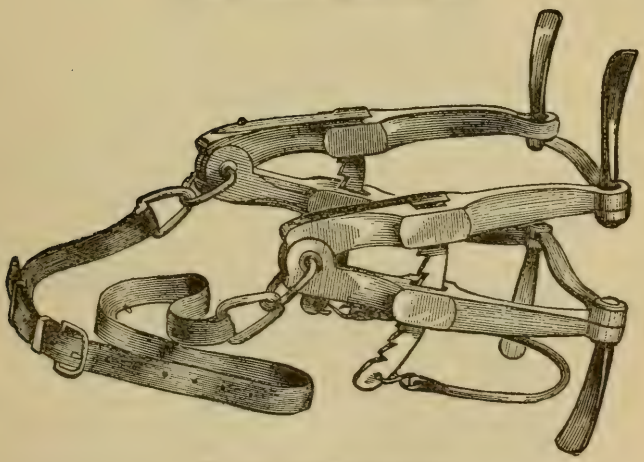


FIG. 74.—Grange's Speculum.

the tongue out of one side of the mouth with one hand, while the cheek is pulled out in the opposite direction with the other. This same manipulation may answer for large ruminants, providing the head is kept elevated by an assistant. In swine, a gag (See fig. 58) made of wood, is often used, and the speculum represented in figure 61 answers well for dogs. At other times, however, with these animals, the mouth is kept open by separating the jaws with tapes passed around each, and pulled apart.

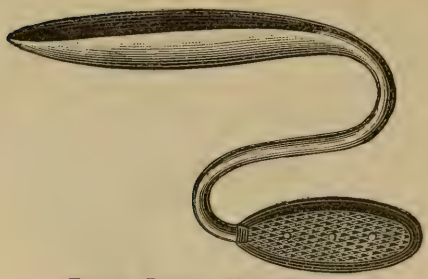


FIG. 75.—Reynal's Mouth Reflector.

Reynal is the author of an instrument which facilitates the examination by the eye of some parts of the mouth. It is polished on both surfaces, and acts as a reflector, and, when introduced on the inside of the cheek, will help to detect diseased spots on the teeth, which would otherwise escape discovery. The

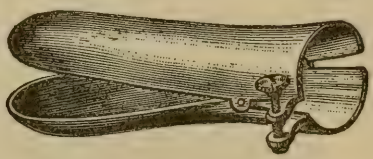


FIG. 76.—Nose Speculum.

speculum to dilate the nostrils and examine the nasal cavities, also acts as a reflector, but fails, we think, to fulfill the object, for lack of sufficient dimensions. It is made somewhat on the principal of the vaginal speculum used in human medicine, and acts in the same manner.

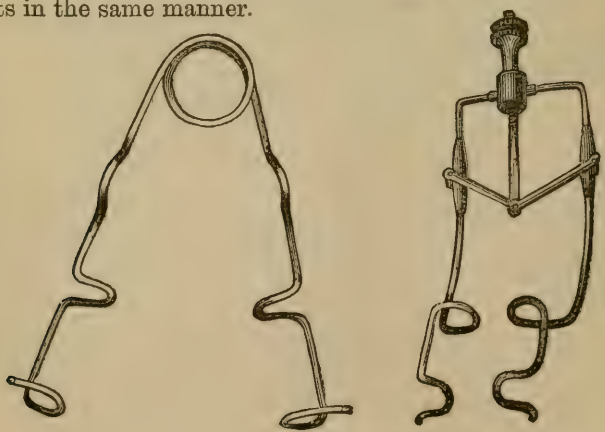


FIG. 77.—Eye Speculums

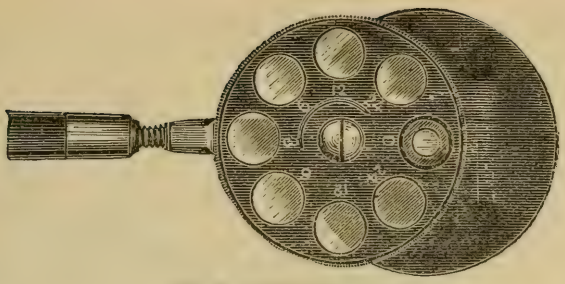


FIG. 78.—Ophthalmoscope.

The speculum to keep the eyelids apart will be found of great assistance in the examination of that organ, so sensitive to the light when in a state of disease, and so constantly kept closed on that account. It is, in fact, this speculum which renders the use of the ophthalmoscope practicable for the examination of the internal structures of the ocular globe.

Some of the various patterns of the speculum used in human

FIG. 79.—Examination of Dog's Ear.

surgery for the ear, will be found available in the examination of the external auditory canal, especially in dogs. The dilatation of the vagina and the anus is scarcely ever needed in veterinary surgery, and instruments are therefore not required; nor is the endoscope, so useful in human surgery, of any value in veterinary practice from the impossibility of using it upon animals.

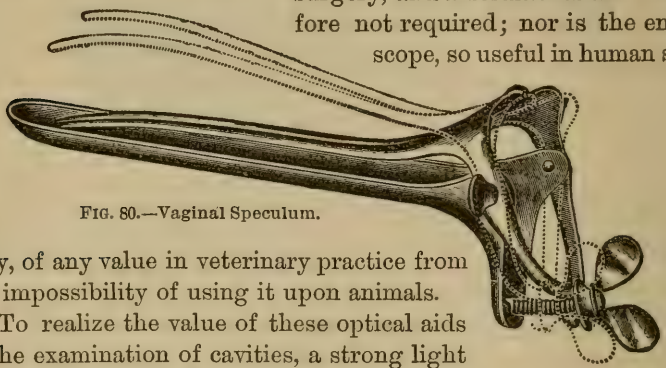


FIG. 80.—Vaginal Speculum.

To realize the value of these optical aids in the examination of cavities, a strong light is indispensable. Sometimes the ordinary solar rays will be sufficient, but at others reflected and concentrated artificial light will be necessary, as in the use of the ophthalmoscope to examine the eye, or to detect the conditions of the deep posterior parts of the nasal cavities.

(*b.*) *Touch.*—The taxis is the surgical sense *par excellence*, and is probably the more valuable and reliable of all the means of investigation possessed by the surgeon, the sight itself not excepted. Nothing else so accurately detects the changes in the proportions, in the consistency, in the elasticity, or even in the nature of tissues, and its discoveries may be made serviceable at every stage of an operation of importance and delicacy. But to attain a reliable certainty in the exercise of this tactical skill, the finger ends must, equally with the eye, be thoroughly educated to perform their functions with accuracy and discrimination. A change in the aspect, form and contour of a region which easily escapes detection by an ordinary observer, will become instantly evident to the well-drilled digital extremities of the experienced operator.

The object requiring examination is not always, however, within reach of any portion of the hand, and resort must be had to instrumental aid in the exploration of parts deeply situated, or of fistulous tracts, and for this purpose the *probe* is brought into requisition. It is usually of metallic material, generally silver, or of lead, or may be made of gutta percha or whalebone, or other

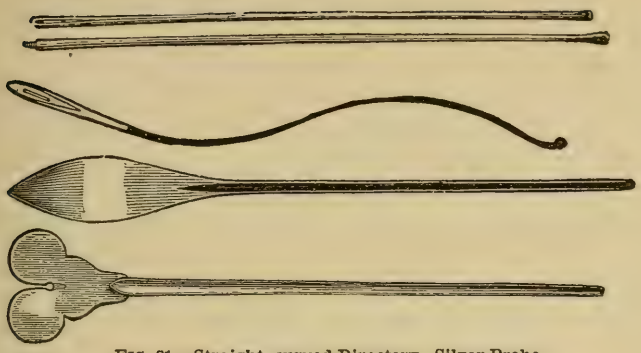


FIG. 81.—Straight, curved Directory—Silver Probe.

suitable, flexible substance, and either straight or curved as the S probe. The director is also a probe, heavier than the ordinary kind, and having a small groove running its length on one side. It is used as a kind of guide to prevent the deviation of the bistoury from its proper course, and to conduct it to the bottom of a wound.

Exploring needles are used with advantage in the detection of the nature of abnormal growths, the small and narrow wound which they make being sufficient to ascertain the nature of the liquid which may be present, without danger of complications.

The Dieulafoy *aspirator* affords another means of exploration and discovery of deep-seated parts, inaccessible in the ordinary way.

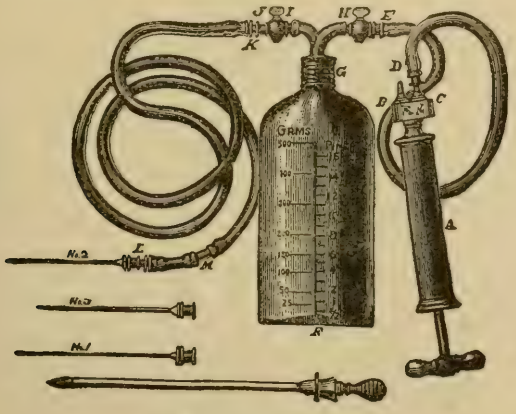


FIG. 82.—Dieulafoy's Aspirator.

(*c*) *Hearing.*—The indications obtained through the media of the sight and the touch may be usefully supplemented, and are often completed by those which address the sense of hearing. The gurgling sound in liquid or gaseous tumors, the peculiar bruit in aneurisms, caused by the current of the blood; the contact of a stone in the bladder when touched by the exploring catheter; the peculiar *glou-glou* of the entrance of air into a vein; the characteristic crepitation of fractures, and the whistling of a roaring horse—these, and other signs, convey their information with unmistakable distinctness to the auricular sense.

(*d*) *Smell.*—The exercise of the olfactory sense in the formation of a surgical diagnosis is more limited than those just considered, and yet there are conditions in which it may be of great importance.

The odor, *sui generis*, of gangrene and of necrosis are promptly detected, and at once recognized, and the existence of other pathological conditions, as of urinary or stercoral fistulous tracts, and certain affections of the feet, are betrayed by the pungent and aggressive appeal to the olfactory organs.

(*e*) *Taste.*—As free from anything like fastidiousness in respect to offensive contacts and surroundings, as the surgeon must unavoidably become, he draws a line; he insists upon a strict monopoly of his gustatory sense for his own internal uses, and only investigates the domestic animals in an alimentary way, when entirely healthy individuals are reduced to a *post-mortem* condition by the butcher, and served in the form of beef, mutton and pork, properly cooked. But if the surgeon should desire much valuable aid from the exercise of the physical senses in forming his diagnosis, he will commit a serious error if he allows himself to be entirely and exclusively guided by them. Strictly speaking, a direct diagnosis may sometimes be arrived at by a careful collation of the results of his researches, but he will often, also, be obliged to modify or go beyond these conclusions, and make an indirect diagnosis besides.

There are two ways of making a positive surgical diagnosis: one which may be called the direct, or diagnosis by *confirmation*; another known as indirect, or by *exclusion*. The former is by ulterior investigations, confirming a previous diagnosis made upon the basis of a single and prominent symptom; the latter by the elimination of all diseases, which, though they may have some

resemblance to that which has been suspected, yet are excluded by the presence of some specific and incompatible symptoms.

It is only by careful induction and cautious reasoning, that the surgeon can settle the question of his diagnosis, and insure such a true and tangible conclusion, as can only be reached when there is a perfect correspondence between the suggestions derived from the testimony of the physical organs, and the calm deductions of the logical faculty, aided by a disciplined and well furnished memory.

CHAPTER III.

SURGICAL THERAPEUTICS.

This title refers to one of the most extensive and important departments of surgical practice, upon which, indeed, as to its proper administration, depends in a great measure the success of the operative skill, of which it is the supplement and consummation. It comprehends the bandaging and dressing of traumatic injuries.

DRESSINGS.

Gourdon says that "a dressing is a mode of local, periodically repeated, treatment, producing a continued action, following ordinarily the performance of operations, and consisting in the methodical application upon the surface of wounds of special apparatuses, which complete the effect of the operation, and co-operate in the recovery."

The value of the skill and proficiency to be acquired by diligent study and observation in this comprehensive and indispensable art, need not be stated; that it is entitled to be so denominated no one acquainted with the niceties of its details and the judgment and experience entering into their performance, need be told. Nor can the dependence of the surgeon, for the good results which he hopes to secure in *his* department of duty, upon the faithfulness and intelligence of the *nurse*, who is to co-operate with him in perfecting the healing process, be easily overrated. An incompetent or unfaithful nurse, may spoil the best work of a good surgeon. To protect a wound from immediate contact of surrounding bodies, to shield it from injurious atmospheric effects, malarious or otherwise; to keep aloof all putrid and virulent matters; to secure the absorption and neutralization of their morbid products; to control the cicatrizing process in the ulcerated parts; to apply topical treatment, according to indications, as the curative processes develop; to produce a mechanical action, such as dilatation or compression, according to the instructions

of the surgeon, and the indications of the case. Such is a fair, though brief synopsis of the duties of the nurse, upon whom it devolves to give effect to the rules of *surgical therapeutics.*

A well-applied dressing may become the first step toward assuring the success of an operation, those following it—even when only methodically executed—being mere continuous degrees of the one well-begun action. A well-applied dressing may supply the defects and amend the errors of an improperly performed operation; and, on the other hand, a bad dressing may jeopardize the success of a well-executed operation by interfering with the process of cicatrization, and in other ways delay the recovery of the patient, and even prevent it entirely, by causing unfavorable complications.

The application of all dressings is subject to certain general rules, from which no deviation is allowable. As in every action in life, the first step should be that of preparing all the necessary means and appliances for the work, and the last, before beginning the actual manipulation, should be to ascertain that nothing more remains to be provided, at the risk of a serious interruption and delay, and loss of time in a search for some missing article of necessity. On such a point the merest hint should be sufficient, and, indeed, even a hint should be unnecessary with a practical and thoughtful person; but, unfortunately, all persons are not practical and thoughtful.

The next step for the surgeon is to secure for himself and his patient a favorable arrangement in respect to light and room. There must be nothing interposed before the eye, or that can limit the free movement of the hand and the arm—a most obvious suggestion.

Before applying a dressing, the wound should be thoroughly cleansed and freed from blood, pus, the remains of previous dressings, and, in a word, of any foreign or other substances capable of becoming sources of irritation. This is best done with water alone, but its effect is frequently greatly improved by combining with it some of the compounds, such as carbolic acid, sanitas, creoline, etc , which have proved their value as antiseptic agents. It may be applied by carefully passing a fine sponge or a ball of oakum over the surface of the wound, or it may be used more freely in larger ablutions. Crusts or scabs, if any, may be removed with the scissors or scraped away with the spatula, but

the finger-nails must by no means be used for such a purpose, for the twofold reason that it is both filthy and dangerous. Handle the wound only as much as is necessary; all needless taxis irritates—the inference is obvious. If the wound is deep, injections can be combined with the lotions in cleansing it.

With the first dressing, there is probably only blood to wash away, and that should be done thoroughly, not overlooking any portion that may have dried in the hair and on the skin. The essential condition of cleanliness applies not only to the wound, but also to the material used for the dressing, and soiled cloths or bandages, and dirty tow or oakum must be rigorously rejected. And, while insisting on strict cleanliness in the instruments and dressing material, it will hardly be decorous to the surgeon to omit him from the category, and to remind him of the propriety of looking to his own condition, and especially to that of his hands.

In all his manipulations it should be a matter of conscience with the surgeon to treat his patient kindly. Rough handling, loud scolding, threatening or jerking, with a restless animal, to punish him for an instinctive and natural attempt to move under the infliction of pain, will not only be of no service, but, on the contrary, will increase his fright and render him all the less docile and willing to submit in quietness.

In applying the various parts of the dressings, unnecessary pressure should be avoided, especially on soft tissues; and when it is indicated, it should be applied by slow degrees, and as uniformly as possible, packing the wound upon its entire surface, and completed only as the dressing is nearly ended. Assistants should be enjoined to observe the same rules. The dressing should be applied, not hastily, but rapidly; not with the idea of saving time, simply with a view to lose none. The fact of avoiding any waste of time, by working without needless pause, has, moreover, the excellent effect of curtailing the sufferings of the patient, and sparing him much needless pain.

It is always important to watch the effect of the various articles of dressing as they are applied, in order to be certain that they cause no pain either at the time, or at a later period by their shape, the roughness of their surface, or their unskillful application; and above all, that they cause no interference with any of the essential functions of the economy, as the respiration or cir-

culation. This last especially may be impeded by excessive pressure. To avoid this, bandages applied upon one of the extremities of the body should be so placed as to direct the pressure from the periphery toward the center. If applied in the opposite direction, more or less strangulation might result, causing considerable swelling below the bandage. In fact, all unnecessary or exaggerated pressure is liable to cause inflammatory swellings, erysipelous engorgements, or local gangrenes.

The maintenance of an equal and regular pressure will obviate all danger of deformities of parts, and when methodically applied upon irregular wounds, wherever needed, will serve to restore or preserve them in the natural contour of the region. Neatness and finish should be studied as much as possible, but not, of course, at the expense of any of the special and essential objects of the dressing.

Besides these general rules there are others relating to minute points and touching the various elements, which, as a combined whole, constitute the completed transaction, such as those relating to the topical treatment, to the material used, to the rollers or bands, and to the bandages proper. The medicinal compounds used for topical treatment are either applied alone or through the medium of other materials. They are of various natures and consistencies, from that of the almost impalpable vapor used for spraying, to the liquid forms in the numerous watery solutions, alcoholic tinctures, and oils or liniments, to the hard and other solid compounds in the various astringent, absorbing, stimulating or caustic powders, or the soft pharmaceutical mixtures, the cerates, the pomades, the ointments, the plasters, poultices, etc.

The application of the material used should receive attention from the surgeon. An invariable rule should be to avoid all irregularity, roughness and unevenness, and to be careful that the exterior application rests upon a regular and uniform surface. For this reason it should be the order, in applying this material, always to begin by using the smallest portions, increasing gradually to the largest, thus filling first the small infractuosities and making an even surface, to be covered with larger ones and thin pads, then with thicker ones, and finally with those of the widest dimensions, which should bear a margin extending somewhat beyond the outlines of the wound. The entire dressing is to be

maintained in position by means of compresses, rollers or bandages, as the case may require.

Rollers are long bands of muslin, linen, or ticking, or broad tapes, which are used principally in dressing wounds of the extremities, or of regions liable to much motion. Their length and width vary, according to the requirements of the case. The surgeon will do well to assure himself of the dimensions of these, and to ascertain that the rollers are of ample length, with something to spare, which excess in length can be cut off. Deficiency in the length of a roller will interfere with a perfect completion of its application. If too wide, it may prove difficult to apply it neatly, while if too narrow it may have a tendency to act like a ligature, and make even pressure difficult, besides being more liable to slip and become loosened. Rollers are applied either dry or moist. When moist, they become loose in drying, and their action becomes insufficient. Dry rollers ought, therefore, to be preferred.

Bands or rollers are prepared in two ways, either by being rolled on one or on both of their extremities, and are therefore called the *single* or the *double* roller. In applying it, the extrem-

FIG. 83.—Single and Double Roller Bandage.

ity is first folded tightly to make a small cylinder, which is held by its extremities between the thumb and index finger of the left hand, resting by its width between the same fingers of the right; and while the fingers of the left hand turn the small central cylinder, the band is rolled upon it to its end. Rolling on both ends is done in the same manner. When half of it is rolled, a pin will secure it and prevent it from becoming slack until the other half is made ready to be used. In rolling the bands, slight traction should be made at intervals by the thumb of the right hand, while the fingers of the left keep the central cylinder steady—the object of which is to have the roller firm, hard and solid.

In large establishments, or even in private practice where great numbers may be required, the use of the small apparatus represented in Figure 85 will be found very advantageous, the

FIG. 84.—Manner of Roling a Bandage.

band being rolled upon the central rod with facility, and when removed having the necessary qualities of a well-rolled bandage. The general manner of applying a roller bandage is very simple. Placing with one hand the end of a single roller, or the middle of a double one, upon the part to be covered, and keeping it steadily in position, the other hand holding the mass of the bandage with

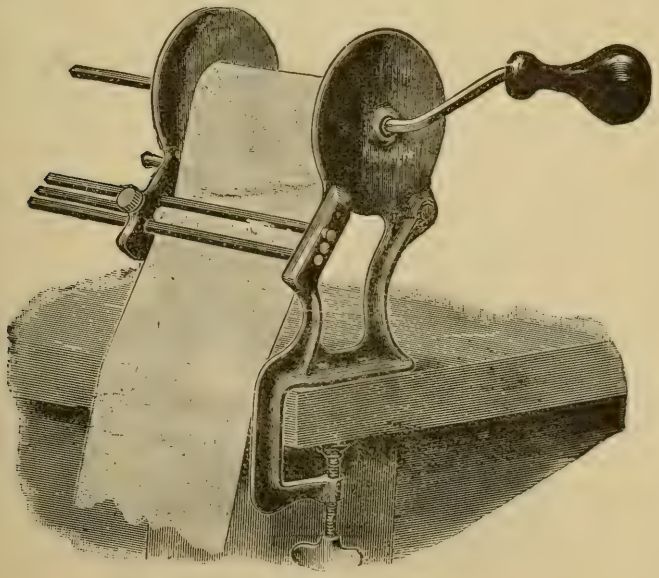


FIG. 85.—Bandage Roller.

the roll turned upward, gently draws on it away from the starting point, unrolls it, and with it surrounds the entire region in returning to the starting point. This process is continued until the band is exhausted, when it is secured by pins or by strings. Thus applied, it may be laid in a circular manner, when the turns rest exactly upon each other, or in a spiral manner when they overlap each other in part of their width, or in a crossed or figure of eight manner, when the turns cross each other to meet always at a given point. If they are applied upon cylindrical surfaces, the folds generally lie smoothly and evenly upon each other as they are successively formed, but if the region is of conical shape or otherwise irregular in form, one of the borders will adapt itself more readily to the parts than the others. Hence the formation of bulging parts or pockets, which render the smooth and proper application of the bandage very difficult, and may interfere with its solidity. This is avoided by giving to the roller an oblique half twist, which, while it changes the gaping border in its position, prevents the slackening of the bandage and removes the pocket. This is principally required in the bandaging of the lower part of an extremity (Fig. 86).

The application of bands on double rolls is also subject to the

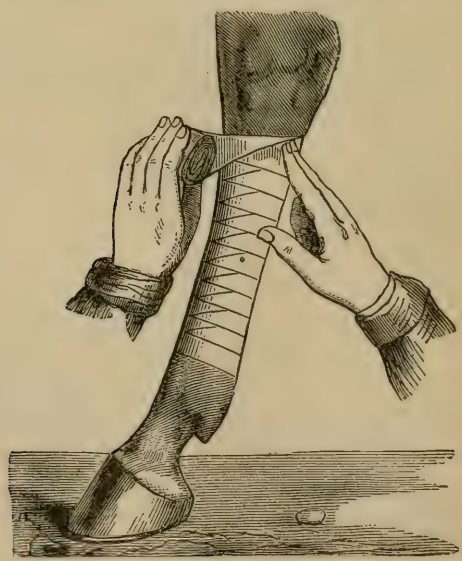


FIG. 86.—How to Apply a Bandage.

rules we have given. The completion of the process by the application of the final dressings and proper finishing steps can scarcely be subjected to rules which could not well be framed to meet the varieties in the features and circumstances of the diversified cases constantly occurring in practice. The only strictly general rule that can be established, is, that when a bandage is placed on the outside of a dressing, it must always, first of all, be fixed at the points which are the most essential to secure it and maintain it in its proper place.

The proper time for the removal or change of a dressing, is a question which depends for an answer upon the consideration of the nature of the wound, the season of the year, the age and condition of the patient; in fact upon all the various circumstances which in the judgment of the surgeon may influence the progress of the cicatrization.

On general principles, the first dressing is not to be removed until the suppurative process is thoroughly established, which is towards the fourth or fifth day. But there are cases where special circumstances indicate an earlier or a later removal. For example, if the dressing has been applied to control the hemorrhage of a divided blood vessel, from twenty-four to thirty-six hours are generally sufficient to obtain the obliteration of the vessel. Again, while it is justifiable to leave the dressing of a foot, which has been subjected to an operation, for eight, fifteen, twenty, and even twenty-five days without changing, and especially in these days of antiseptics when so much is possible in the way of combating the suppurative process, there are no doubt cases where it must be looked after earlier, as where there is an exhibition of increased pain, instead of the abatement which might be justifiably looked for if the operation and the dressing had been properly executed; the increase of pain indicating some complications which early exposure might easily have controlled. There are, however, conditions where the removal of a dressing is indicated in some more than in others, as, for instance, when suppuration is abundant. In these cases, to prevent the retention of the pus in the wounds, and to diminish the danger of its presence, or of its absorption, or facilitate its escape, drainage tubes must be used, or the dressing changed.

The removal of a first dressing usually involves an attention to minute details not subsequently required, the various parts

which compose it being often impregnated with blood and glued together by concreted pus, causing, if removed carelessly, the laceration of tissues, tearing of granulations, hemorrhages, etc. It must especially be ascertained whether adhesions exist between the material of the dressing, and if they are present they must be thoroughly soaked by means of compresses wet with tepid water, or a warm water bath, if the dressing is upon a region which allows it, as, for instance, one of the extremities. When this is done, the various constituents of the dressings may easily be removed, one by one, but care and deliberation will still be necessary. The smaller particles should be removed with the forceps, not the fingers. If the location allows it we even prefer to wash these away by irrigation, with a stream of luke-warm water, or by soaking thoroughly in a foot bath. The wound is to be cleaned out carefully, by soaking or *sopping* away the pus with fine sponges, avoiding all rubbing upon the granulations or causing them to bleed. Then studying all the indications, to be discovered in the condition of the wound, and avoiding all unnecessary manipulations, and attentively removing all causes likely to interfere with the repairing processes, the dressing is to be replaced with all the original precautions. As little time as possible, consistent with thoroughness, should be occupied in this process. The wound should be uncovered only as long as necessity requires, the materials for the dressing being all easily accessible without delay or hindrance, being prepared in advance and carefully inspected.

The effects looked for in the application of dressings can be divided into *general* and *special*, these varying in their nature, according to the object which the surgeon has in view. The first and principal object is to protect the wound from exposure to the action of the atmosphere, and also against contact with foreign bodies, thus to relieve the pain, diminish the inflammatory irritation, and accelerate the cicatrization. It also prevents the retention, by their absorption of the suppuration and serosity which form on the surface. They also expedite recovery by maintaining the natural warmth of the body in the region. The *special* effects of dressing, vary according to the special action produced by their application, and these may be considered under several heads.

(*a*) *Retentive dressing.*—This is designed to keep parts in their

normal condition and situation, and thus aid in their union or consolidation, without deformity. It is principally applied in cases of fractures or dislocations, but finds also its main indication in maintaining in their proper place the medicinal substances which are the active agencies of cure.

(*b*) *Uniting dressing.*—That which is made with sutures or adhesive plaster, to hold the parts in their proper position, and maintain their perfect co-aptation.

(*c*) *The suspensory dressing*, which is a variety of the retentive dressing, and serves to support organs of soft texture in some parts of the body, such as the testicles, or the mammæ, which by their position are exposed to traumatism by their situation, their weight, and by pulling and bruises. *Suspensories*, is the name given to these special bandages; they are commonly used in diseases of the testicles, and of the udder.

(*d*) *Compressive dressings.*—These are devised to produce more or less active pressure upon a too active granulating surface; to arrest hemorrhage, to change the vitality of some tissues of a morbid nature, or to control the projection of abnormal bony growths.

(*e*) The *dividing dressing* is the opposite to the *uniting.* It is of common use in cases where too rapid closing of wounds is to be prevented. It is applicable in infundibuliform surfaces, in deep fistulous tracts, and in wounds which are the seat of foreign elements, pathological or other. It operates by keeping the superficial opening of the wound dilated, by means of tents, sponges, etc.

(*f*) *Expulsive dressing.*—The object of this dressing is to assist the exit of pus from the surface of wounds. A simple dressing, by its absorbing properties, is somewhat of an expulsive nature. The presence of a single tent of an absorbing quality, as small balls, or padding of absorbent cotton; the application of *drainage* tubes; all these facilitate not only the escape of the secretions, but also the discharge of the morbid products. The drainage is obtained by the introduction into the wound of India rubber tubing, of various dimensions, perforated at intervals upon their length, and kept in position by safety pins inserted through them and the skin, at suitable points. These tubes, when extending through the depth of a wound, embracing its whole length, and projecting through a counter opening, as well as through the

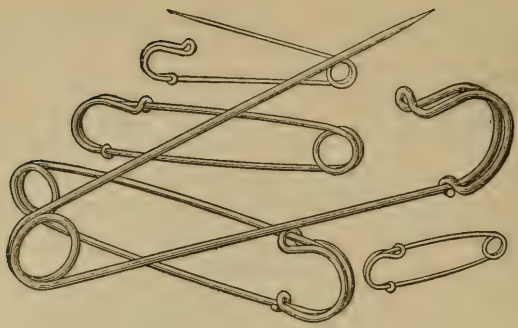


FIG. 87.—Safety Pins.

natural ones of the wound, form an excellent means for continuous irrigation, in the treatment of fistulous withers, complicated poll evil and other diseases.

(*g*) *Antiseptic dressing.*—Is intended to prevent the entrance of micro-organism into wounds, to neutralize their morbific effect, to check their development, and thus prevent their septic influences from taking effect. The application of the Lister dressings, with the care required in the preparation and application by the surgeon; of the instruments and materials included in the arsenal of pharmaceutical resources, comprising the antiseptic sprays; the various acids, boracic, carbolic, and salycilic; the alkaline sulphites and hyposulphites; permanganate of potash; solutions of bichloride of mercury and of creoline; antiseptic gauze and absorbent cotton—all these, and more constitute dressings essentially *germicide*, which cannot be too confidently recommended to the attention and adoption of the veterinary surgeon.

The application of the wadding dressing, so highly recommended by some, has given, in our hands very satisfactory results, in many cases. Wadding well prepared and properly applied, forms an almost invincible obstacle to the introduction of micro-organisms, and according to Pasteur, by its direct action upon the pus renders fermentation impossible.

The instruments necessary for the adjustment of dressings, are generally speaking, numerous and varied. They consist of forceps of all kinds, the ordinary dissecting, the bull-dog, the straight, and the curved dressing forceps; scissors, directors,

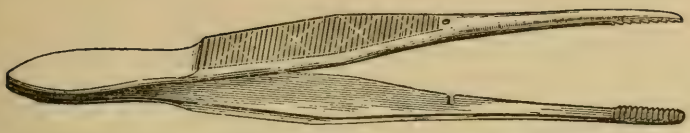


FIG. 88.—Dissecting Forceps.

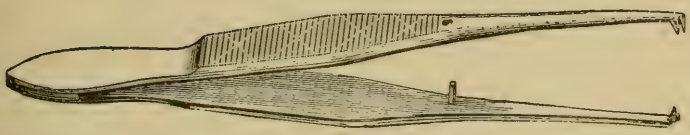


FIG. 89.—Bull-Dog Forceps.

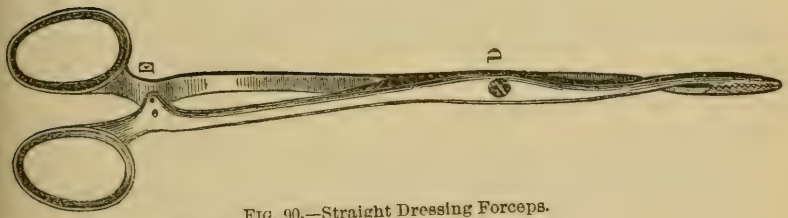


FIG. 90.—Straight Dressing Forceps.

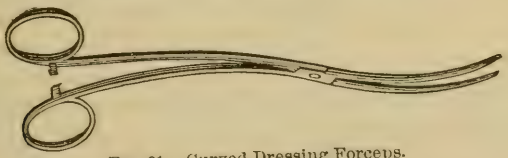


FIG. 91.—Curved Dressing Forceps.

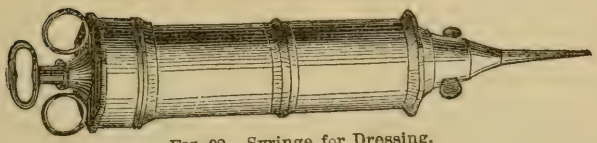


FIG. 92.—Syringe for Dressing.

spatulas, the S. probe, and others; syringes, and sometimes atomizers, and also razors, enter into the list of those generally needed.

The materials used to form the base of the dressings vary: charpie, wadding, wool, moss and sponges, are employed. Their costliness as respects their commercial value, is probably the reason why they are not more generally adopted in the practice of veterinarians. Oakum is the material, *par excellence*,

for the application of dressings in veterinary surgery, and is even commonly used in human surgery. We are almost tempted to claim for it the distinction of having been especially created for the benefit of wounded horses, its various and valuable qualities so obviously fitting it for the uses to which it is appropriated in the equine clinic. It is excellent as a defense against the contact of external bodies, and in preserving a uniform temperature in the parts covered by it. From the sponginess of its consistency it readily soaks and absorbs the fluids which form upon the surface of a wound, while the tar with which it is more or less impregnated confers upon it slight antiseptic properties, which assist in the stimulation, and are in themselves favorable to all the processes of cicatrization. To be of good quality, it must be clean, soft to the touch, and free from any foreign substance. Sometimes it is cut into small portions for use, but more generally in strips, or in such other special shapes as may be required. It is made into *balls* by spreading out little masses of the fibres, which after being separated from each other, are rolled between the hands, into the required forms and sizes. They are exceedingly convenient in

FIG. 93.—Ball of Oakum.

constituting the first steps of this application of a dressing. It is also made into *pads or cushions*, by stretching the fibres parallel, into any given width and length, and folding them into the similitude of a small mattress. This must be soft, and free from lumps, or fragments of wood, and of an even thickness through-

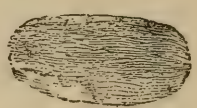


FIG. 94.—Pad of Oakum.

out. These are made also of various dimensions, the widest and thickest being used to cover the outside of the wound. It is also shaped into *dossils*, *rolls*, and *tents*, *or plugs*, the adaptation of which remains yet to be considered.

BANDAGES

The catalogue of means and appliances for dressing is by no means exhausted in those already mentioned. Among them are the various forms of compresses, the rollers, the splints, the plates and the means of drainage, with the various forms of rolled bandages, wide bandages and mechanical bandages.

(*a*) *Compresses.*—These are pads made of linen, of various sizes and shapes, and folded to any degree of thickness required, which are sometimes applied immediately upon the wound, but usually upon the oakum. They are not, however, of frequent use in veterinary surgery, except under special indications. They may be square, long, triangular, shaped like a neck-tie, or like a Maltese cross, either complete or half, double or treble-tailed, and generally patterned and graduated according to the form required

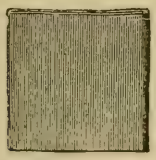


FIG. 95.—Square Compress.

FIG. 96.—Long Compress.

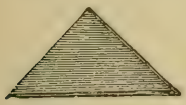


FIG. 97.—Triangular Compress.

FIG. 98.—Neck-Tie Compress.

FIG. 99.—Maltese Cross Complete.

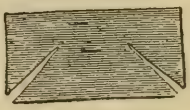


FIG. 100.—Half Maltese Cross Complete.

FIG. 101.—Double Compress.

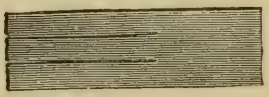


FIG. 102.—Treble Compress.

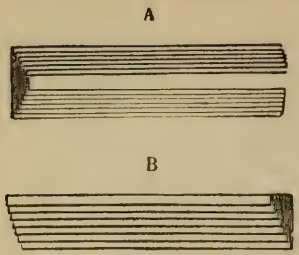


FIG. 103.—Graduated Compress.

FIG. 104.—Perforated Compress.

by the case. They are commonly used in their entire thickness, but are sometimes made with a hole in their center, and then receive the name of *perforated* or *fenestrated.*

(*b*) *Rollers* have already occupied our attention.

(*c*) *Splints.*—These are long, flat, and more or less rigid strips of wood, or other material, designed to be added to other dressings, to give them some peculiar form or position, and to consolidate and strengthen them by increasing their rigidity. They are usually applied upon the extremities or superior parts of the body, and are composed not only of wood, but of hard leather, pasteboard, tin, gutta-percha, etc., etc., and maintained in position by bands or adhesive mixtures. They must be carefully and accurately applied in order to avoid chafing or excoriating the skin, and are often padded, and their borders made especially smooth and uniform.

(*d*) *Plates.*—These are small pieces of metal or wood, used principally in the surgery of the foot, to keep in place dressings of the plantar region, which require more or less pressure upon

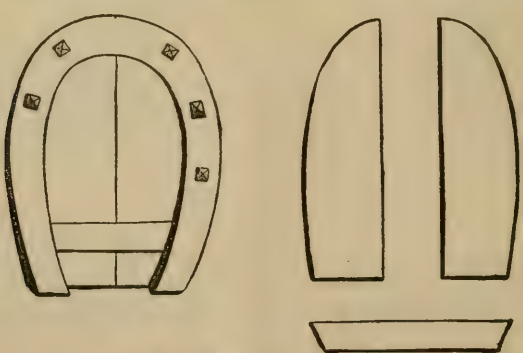


FIG. 105.—Plates on Shoes.

their surfaces. They consist of separate parts or sections, representing together the entire surface of the sole, one section sliding on each side, between the foot and shoe, and are kept in place by a third and narrower section, introduced transversely between them and the shoe, towards the heel. It is important to ascertain, before applying them, that sufficient room exists between the sole and the shoe, and also that the wall is not in such close contact with the shoe at the heels as to prevent the introduction of the cross pieces.

(*e*) *Means of Drainage.*—The conduit most commonly used is a vulcanized india-rubber tube, which is introduced into wounds to facilitate the escape of purulent and other discharges, and to keep them in a cleanly state. They are of various dimensions, as to the length and diameter, to accommodate those of the purulent cavity, and are perforated at the side throughout their length, in order to collect and receive all the impurities that may be present. Instead of tubes, long tents of oakum are sometimes introduced into a wound, for the purpose of absorbing the impurities, and to serve as a means of drainage also.

(*f*) *Roller Bandages.*—These are the simplest of bandages. They are applied with one or several rollers. We have already mentioned their division into circular, spiral, figure 8, etc.

(*g*) *Wide Bandages* are made of broad, thin pieces of linen, ticking or canvas in various forms, to adapt themselves to any part of the body where they may be needed. They are sometimes folded into pads or cushions, and employed as a means of applying moisture. Those invented by Dr. Berns (Fig. 106) for this purpose may be used with advantage. They are kept in place by tapes or ribbons, which must be arranged and fastened about the body according to the judgment and ingenuity of the surgeon.

The number of wide bandages is indefinite, and, according to Bourgelat, twenty-seven species can be classified and enumerated. He would prove himself, however, but an indifferent practitioner who should find himself unable, upon occasion, to improve the catalogue by adding new devices to meet new requirements.

In examining some of the principal varieties of the wide bandage, we shall borrow from the excellent work of Peuch and Toussaint. Our reference will be to

1st. *Simple Frontal.*—This is a piece of cloth covering the greater part of the forehead and the summit of the head or poll,

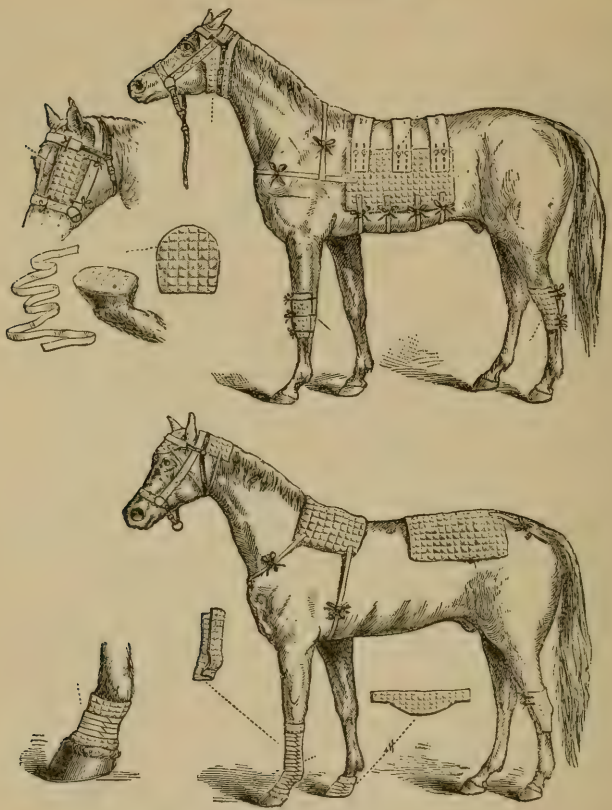


FIG. 106.—Berns' Molstened Pads.

with a fold superiorly to receive the *forelock* or *toupet*, and secured by four bands. The lower two have either a small opening or loop, which the upper two pass before extending down below the throat, to cross each other in the form of an X, and drawn upwards in the lateral faces of the head to the poll, where they are held (Figs. 107, 108).

2d. *Compound Frontal.* — This is shaped like the former, but extends further down on the face. It has six bands, the middle ones having also loops at their free extremity, as in the preceding, the upper ones being also secured in the same manner, the lower ones crossing each other under the jaws, and also carried upward to pass through the loops of the middle bands, to be either tied on the poll, or drawn downwards and tied in the maxillary space (Figs. 109, 110).

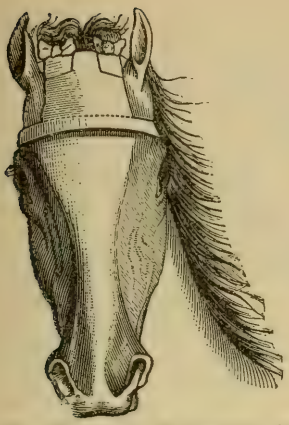


FIG. 107.—Simple Frontal (full view)

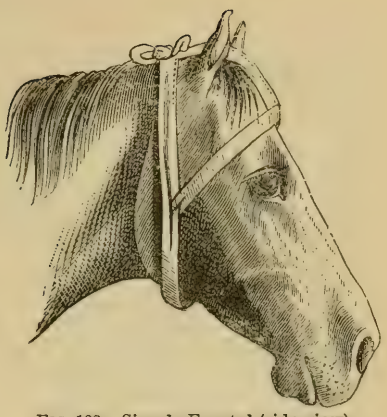


FIG. 108.—Simple Frontal (side view).

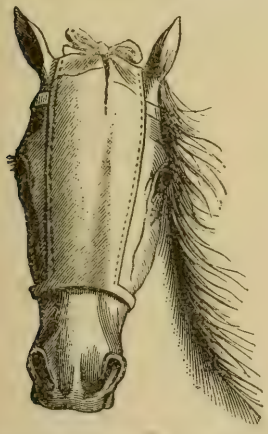


FIG. 109.—Compound Frontal (full view).

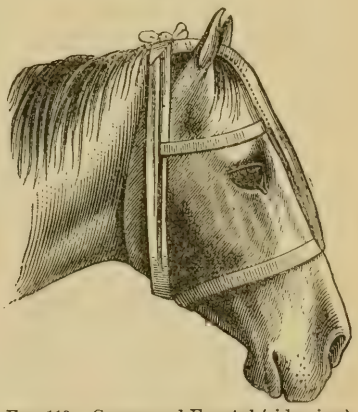


FIG. 110.—Compound Frontal (side view).

3d. *Monocular or Simple Bandage for the Eye.* This is an oblong square, notched at the angles, corresponding to the ear of the same side, and provided with two transversal folds, to adapt itself to the convexity of the orbit. It is secured by five bands. The upper three are attached to the throat-strap of the halter or bridle, the lower two to the lower part of the same strap (Figs. 111, 112).

4th. *Binocular or Double Bandage for the Eye.*—This is formed of a large piece of cloth, notched on its two superior angles to receive the ears, and secured with eight strings or straps. A longitudinal fold in the upper, and another in the lower part

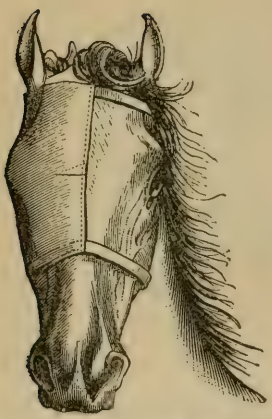


FIG. 111.—Monocular Band (full view).

FIG. 112.—Monocular Band (side view).

of the bandage, facilitate its adaptation to the surfaces it is to cover (Figs. 113, 114).

5th. *Bandage for the Maxillary Region.*—This is of triangular shape, and is formed either of sheepskin or of two layers of cloth, between which a pad of oakum is sewed. It is furnished with four straps. When applied, the base of the triangle is turned backward, and the apex rests in the angle of the maxillary space. The two upper straps, attached at each angle of the base of the triangle, pass upward at the side of the parotids, and are tied on the summit of the head, the two lower ones attached at the apex of the triangle, passing over the nose to be tied at that point. We have often obtained a better adaptation of this bandage by utilizing the cheek or the nose-piece of the halter.

6th. *Ear Bandage* (Figs. 115, 116).—This is made of two triangular pieces of cloth, united at their base on the summit of the head, each forming a kind of inverted pocket, with which the ears are covered. It is secured by six bands, the two superior having loops through which the middle ones pass, these crossing each other under the throat and extending upward to be tied on the poll. The lower bands cross each other on the forehead and pass under the head, to return on the lower part of the face where they are secured. Another way to apply a dressing on the ear to envelope it properly is to use a thin bandage, which, after it has enveloped the ear, is passed around the head on each side, and secured under the throat (Figs. 117, 118). When supported by a tightly

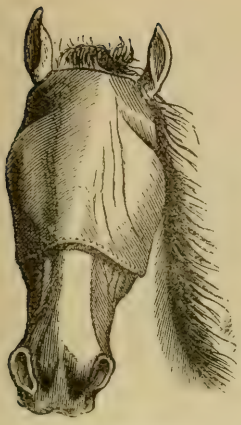


FIG. 113.—Binocular Band (full view).

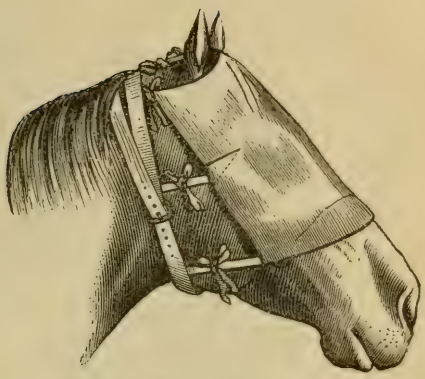


FIG. 114.—Binocular Band (side view).

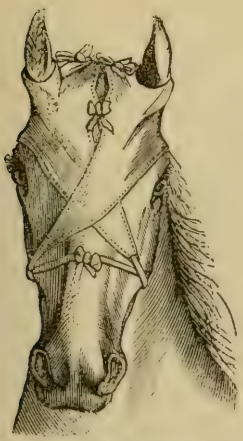


FIG. 115.—Ear Bandage (full view).

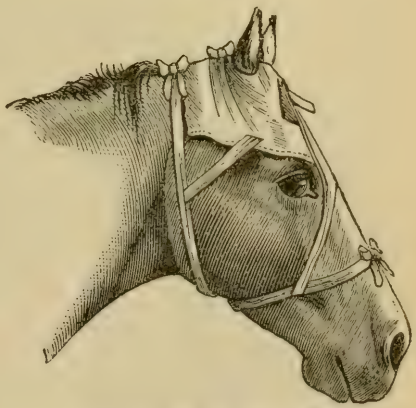


FIG. 116.—Ear Bandage (side view).

fitting halter this bandage maintains its position in a manner quite satisfactory. To this kind of bandage can be added the one used for dogs under the name of *cap*, which is made of soft cloth or fine cord net. The caps recommended by the Germans answer the purpose also very well (Figs. 120, 121).

7th. *Bandage for the Parotids or Throat.*—This bandage is long and square, and is notched in the middle of the two borders to secure the inferior border of the neck, and adapt itself to the maxillary space. It covers the parotid, and is secured by four

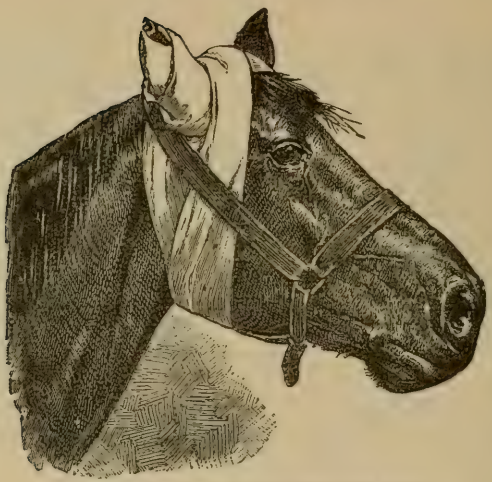


FIG. 117.—Bandage for the Ears (side view).

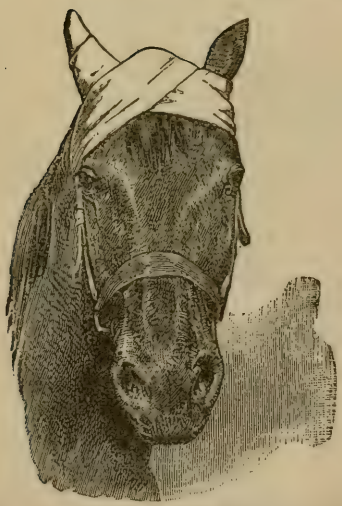


FIG. 118.—Bandage for the Ears (full view),

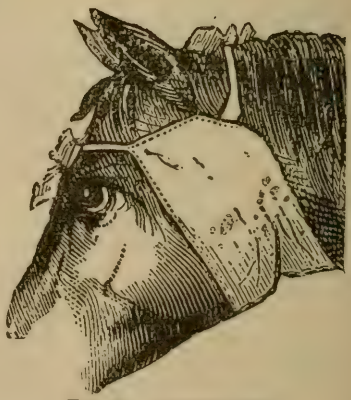


FIG. 122.—Parotids Band.

bands, two attached in front of the forehead, the others on the poll. This bandage is often combined with that of the maxillary region, and made in a single piece (Fig. 122).

8th. *Bandage for the Superior Border of the Neck.*—This bandage is a long piece of cloth placed upon the dorsal border and lateral faces of the neck, with a prolongation in front, passing

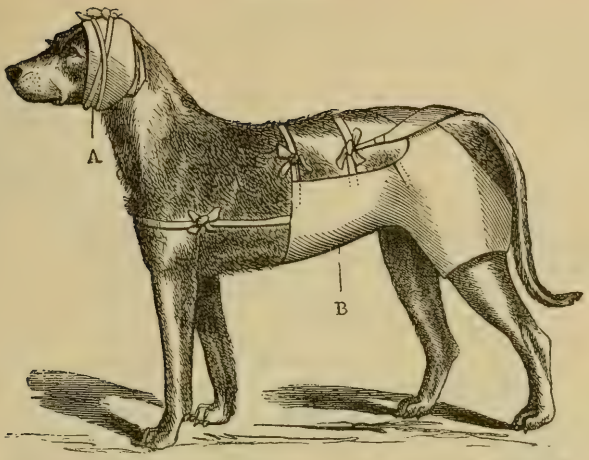


FIG. 119.—Bandage for the Ears, A. Bandage for the Mammæ, B.

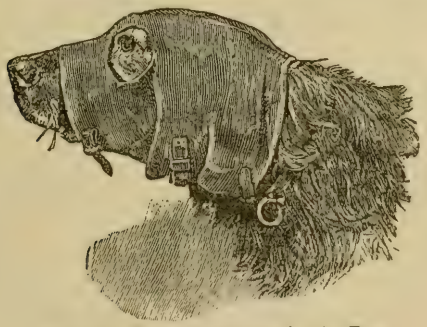


FIG. 120.—German Bandage for the Ears.

FIG. 121.—Another German Bandage for the Ears.

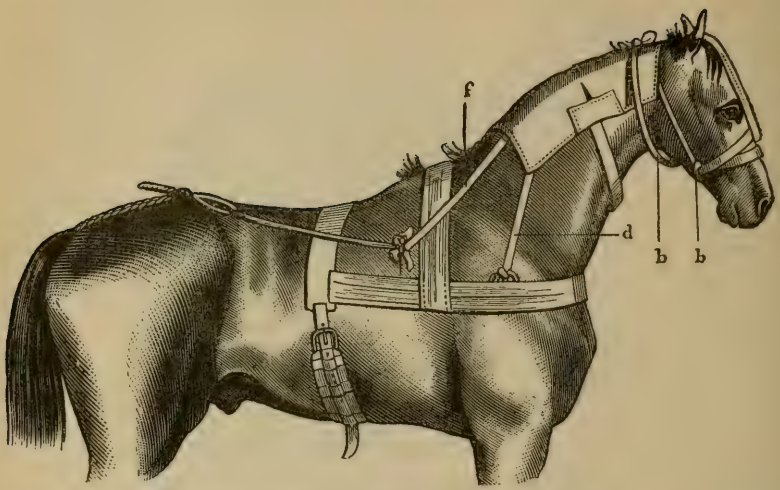


FIG. 123.—Bandage for Superior Border of the Neck.

between the ears and down to the forehead. Eight bands secure it. The two inferior bands (*b*) have loops through which the bands pass to cross each other under the maxillary bones, and extend upward on each side of the head to be tied over the poll. The bands (*d*) are fixed on the breast-band of a Dutch collar, and (*f*) is attached to the surcingle (Fig. 123).

9th. *Bandage for the Anterior and Lateral Parts of the Neck.*—This bandage is octagonal, with a band at each angle. The anterior are tied on the forehead or on the throat-strap of the

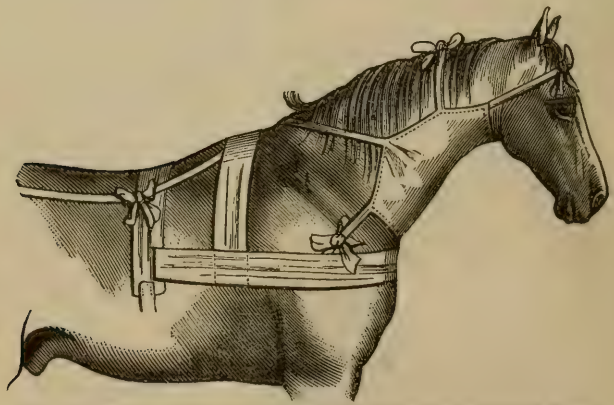


FIG. 124.—Bandage for the Anterior and Lateral Parts of the Neck.

halter, the middle ones over the dorsal border of the neck; the posterior cross each other over the withers, and are secured to the surcingle, as are also the two lower (Fig. 124).

10th. *Bandage for the Withers.*—This is square, truncated at its posterior angles, and having in the middle of its anterior and posterior border a fold to adapt it to the height of the withers. There are five bands. The anterior are secured forward, above

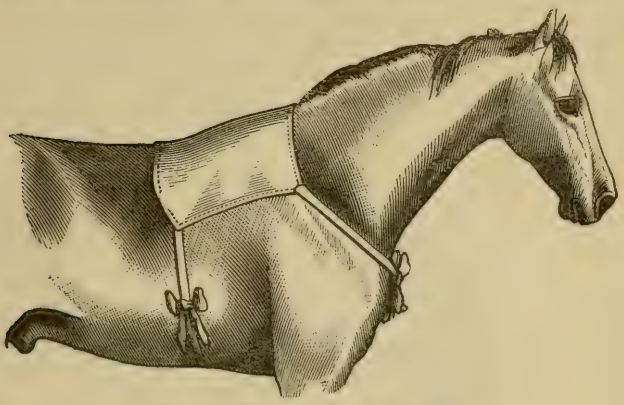


FIG. 125.—Bandage for the Withers.

the breast, the posterior are passed around the thorax and tied together, the other sewed on the middle of the posterior border extending along the spine and attached to the crupper.

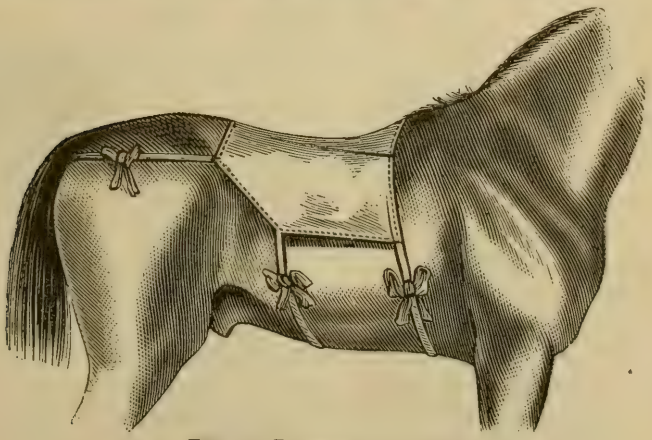


FIG. 126.—Bandage for the Back.

11th. *Bandage for the Back.*— This bandage is composed of a long, square piece, truncated on its two posterior angles, and has six bands, one at each angle. The two in front are tied together after passing around the chest, the middle ones after surrounding the abdomen toward the umbilical region and the posterior are united after forming a kind of crupper in passing under the tail (Fig. 126).

12th. *Bandage for the Loins and Croup.*—This bandage is of a form similar to the preceding, and of sufficient size to cover the croup posteriorly. It is truncated on both posterior angles, and each border, except the anterior, has folds to allow the bands to adapt itself to the rotundity of the region. At each

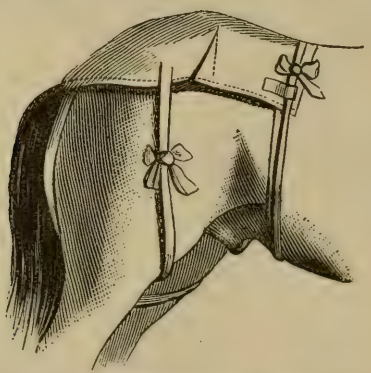


FIG. 127.—Bandage for the Loins and Croup.

angle is a band, the posterior passing around the abdomen, and carried backward and upward to be tied over the loins. The posterior then turns from without inwards, over the round of the hip, crossing obliquely the internal face of the thigh forward to the stifle, and passing over the external face of the thigh to the middle bands on a level with the hip-joint, where they are tied. Two extra bands may be attached to the front border and tied to the surcingle, if thought necessary, to prevent the bandage from slipping backwards.

13th. *Bandage for the Hip* (Figs. 128, 129).—This is formed of a piece of cloth the length exceeding the breadth by one-half, or in the proportion of three to two, and so enveloping the hip and part of the croup that the inner border runs along the perinæum, and the outer on the external face of the thigh and leg.

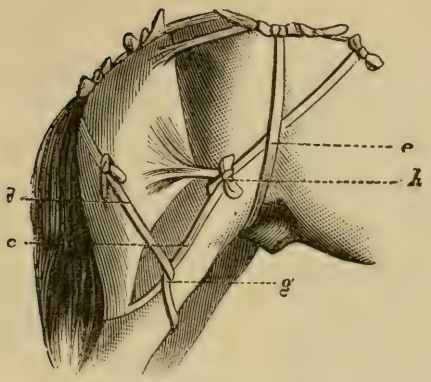


FIG. 128.—Bandage for the Hip.

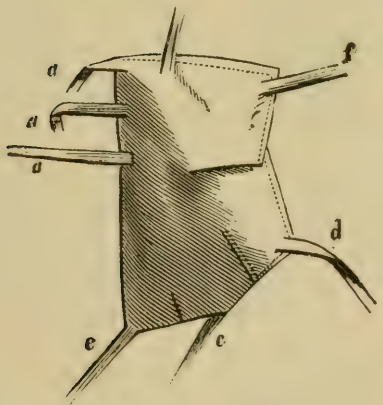


FIG. 129.—The same separate.

This border (*f*, *d*) forms a fold about four inches wide at its base, and the inferior (*d*, *e*, *c*) has two which, like the first, form an exact adaptation to the parts. Eight bands belong to this bandage—three upon the posterior border (*a*, *a*, *a*) at its superior part, which are fixed to the crupper, the superior border having one (*b*) long enough to reach to the surcingle, and the inferior border having three (*d*, *e*, *c*). The bands *d* and *e* pass around the leg and cross each other at *g*, the band *d* being fixed to the crupper, while *e* extends to the surcingle forward. Band *e* crosses obliquely to the inner face of the thigh, passes upward along the

flank, and is tied to the surcingle. The band *f* is fixed upon *e*, as seen in the illustration, Fig. 128 at *h*.

14th. *Bandage for the Inguinal Region and Perinæum.*—This is applied to the testicles or to the mammæ. It is a long, triangular bandage, with its base placed forward, and is provided

FIG. 130.—Bandage for the Inguinal Region and Perineum.

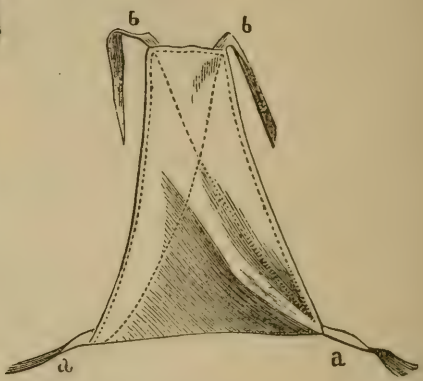


FIG. 131.—The same separate.

with four bands, one at each angle of the base. These are passed around the flanks to be fixed on the loins, the two posterior on the apex of the triangle to draw along the perineum, and passed over, and on each side of the tail, crossing each other to join the first one, to which they are tied.

15th. *Bandage for the Abdomen.*—This should be oblong in shape, its length double its breadth, and having folds on each of its long sides to adapt it to the convexity of the body. The bands are six in number, two of which are fixed on the loins, two on the back, and two over the withers. A seventh is sometimes added, which passes around the base of the neck and prevents the bandage from slipping backwards (Fig. 132).

16th. *Bandage for the Chest.*—This is square, with a prolongation in front to go between the fore legs, and which is notched on the front to adapt itself to the chest behind the elbows. The bands are six, one at each angle, and two on the prolongation in front. These are fixed in pairs, over the back, the loins and the withers (Fig. 133).

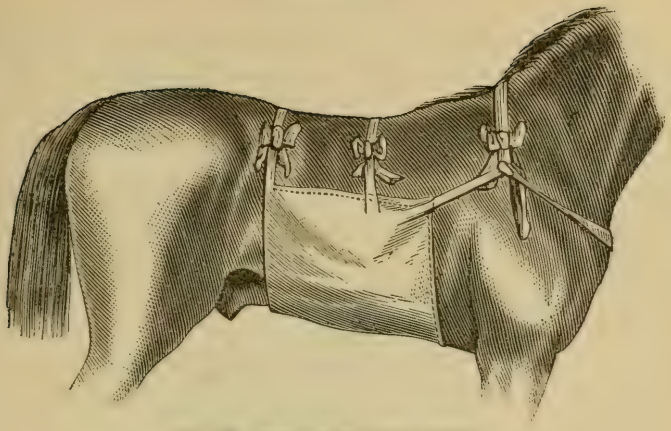


FIG. 132.—Bandage for the Abdomen.

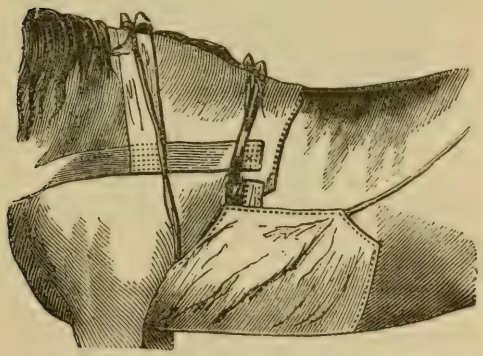


FIG. 133.—Bandage for the Chest.

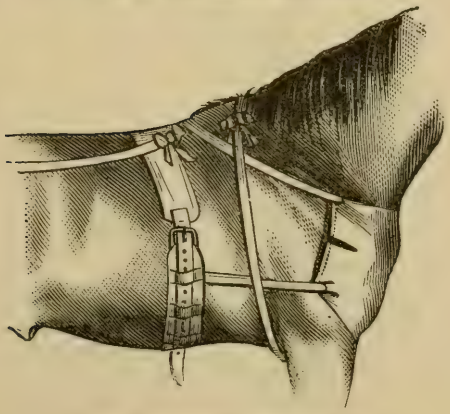


FIG. 134.—Bandage for the Breast.

17th. *Bandage for the Breast.*—This resembles the preceding, except that the narrow prolongation is attached under the chest to the surcingle, or, surrounding the forearm, goes to the withers. The others are tied over the withers and on the sides of the chest to the surcingle (Fig. 134).

18th. *Bandage for the Shoulder.*—This is cut in the form of a trapezium, to cover the shoulder and the arm. It is applied somewhat obliquely, and has on its front borders (Fig. 135) folds to adapt it to the convexity of the anterior part of the arm. Of its

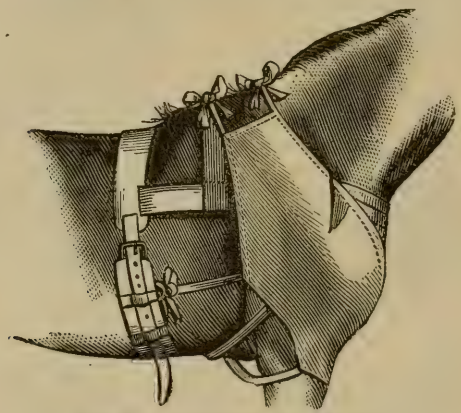


FIG. 135.—Bandage for the Shoulder.

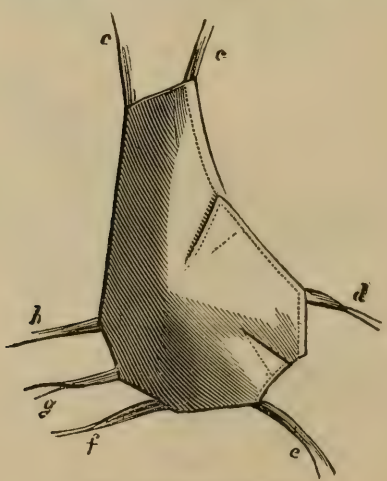


FIG. 136.—Same, isolated.

seven bands, *c*, *c* are fixed on the withers at the origin of the neck, *e f*, passing first around the forearm and joining *c c*, as it passes on the opposite side, and *d*, *g*, *h* are secured to the surcingle.

19th. *Bandage for the Shoulder Joint.*—This bandage is square and truncated on its superior angle, and is provided with several folds to adapt it to the convexity of the shoulder. The

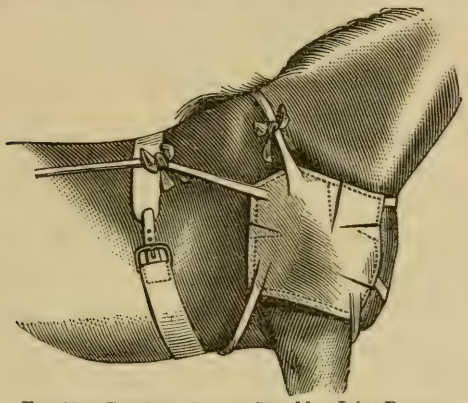


FIG. 137.—Bandage for the Shoulder Joint Proper.

bands are six, three anterior and three posterior. The first two are applied around the neck, the third on a ring at the surcingle; the other three also going to the surcingle, either directly or in passing around the inside of the forearm.

20th. *Bandage for the Elbow.*—This bandage is of an irregular shape, with folds on its lateral and lower borders, to adapt

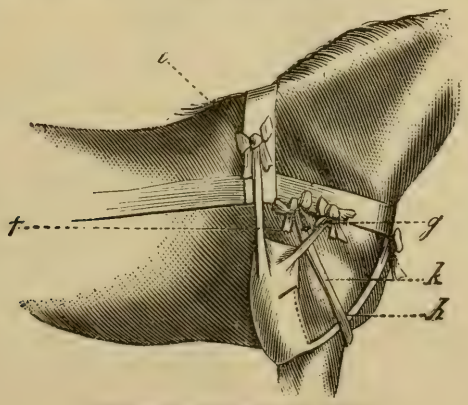


FIG. 138.—Bandage for the Elbow.

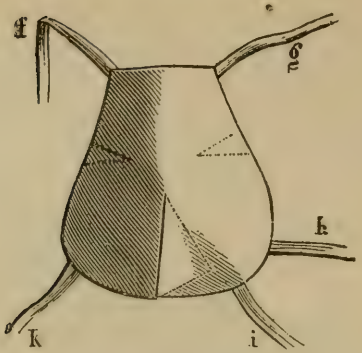


FIG. 139.—Same, isolated.

it accurately to the point of the elbow. Five bands serve to confine it, *f* going directly to the withers where it is tied with *i*, previously passed under and around the thorax on the opposite side, *g* and *h* are secured to the breast-band of a Dutch collar, *k* passes around the forearm on the inside, from behind forward, and passes in front of the breast to be also secured to the Dutch collar.

21st. *Bandage for the Forearm.*—This is of an irregular triangular sharp, with the apex truncated, and the base notched to accommodate itself to the axilla and the fold of the elbow. When applied, the apex of the triangular, which forms a short border, is turned downward and the base upward in the axilla. Two bands sewed to each angle of the base are fixed to the breast-band

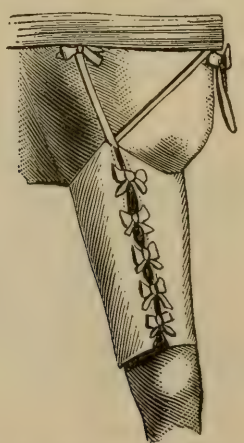


FIG. 140.—Bandage for the Forearm.

of the Dutch collar, and the borders are secured by little tapes on the outside of the forearm. Sometimes these borders are fastened together by laces inserted obliquely.

22d. *Bandage for the Knee.*—This is square, notched on its superior border and in the center, both of which are provided with a small piece to form a gusset, in which the bony projections of the knee are secured. A double, ordinary band, or, what is better, an elastic strap attaches it to the breast-band, while smaller tapes serve to tie it to the back of the knee.

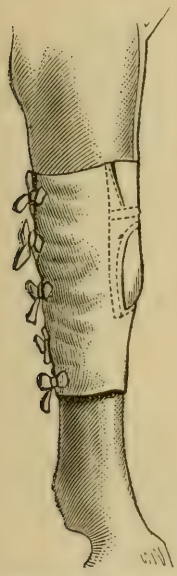


FIG. 141.—Bandage for the Knee.

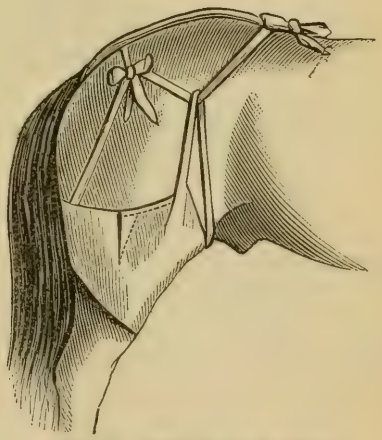


FIG. 142.—Bandage for the Stifle.

23d. *Bandage for the Stifle.*—This is of a triangular figure, the base of which should be four times longer than its height. It has three bands, one at each angle. That of the superior angle passes along the flank, and is attached to the crupper strap at the loins; that of the inferior angle twists forward and inward on the thigh, and connects with the crupper at the base of the tail, while the third band turns around the crupper, crosses the internal face of the thigh from behind forward, passes in front of the stifle, and terminates backward at the same point with the preceding band, after twisting around that of the superior angle.

24th. *Leg Bandage.*—This is the complicated device represented in Figs. 143 and 144. It has four bands on its superior border, (Fig. 144 *a*, *b*, *c*, *d*) and the lateral borders have five or six tapes. The bandage has three gussets, two of which, *c*

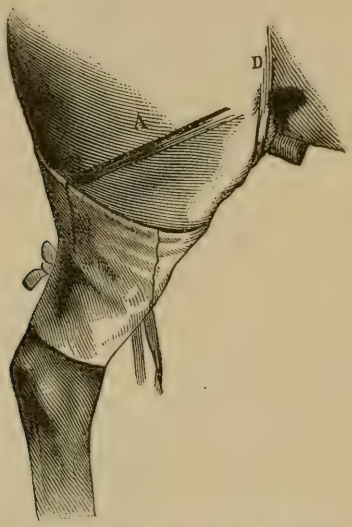


FIG. 143.—Bandage for the Leg Applied.

and *d*, are on the superior border, and one, *i*, on the inferior, and the two lateral borders have each one a fold. To put the bandage in place, the band *d* is passed along the flank upward and tied to the crupper strap, *c*, passing from within outward on the inside

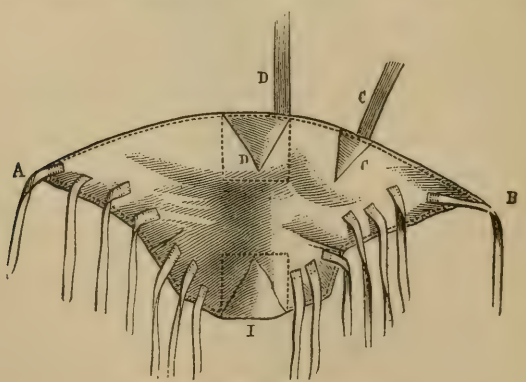


FIG. 144.—The same, isolated.

of the thigh, to be fixed on the round of the crupper. *A* and *b* cross each other at the lower part of the leg, a little above the tendo-Achilles, in order to allow *a* to pass from the inside to the outside of the leg so as to become attached to the surcingle, while *b* is secured to the round of the crupper. The small tapes are, of course, tied together in couples.

25th. *Bandage for the Hock and Cannon.*—This requires a piece of cloth of sufficient dimensions to completely surround the hock and cannon down to the fetlock. Its superior border is

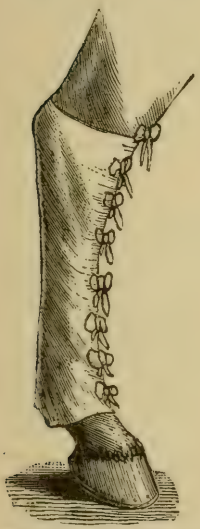


FIG. 145.—Bandage for the Hock and Cannon, applied.

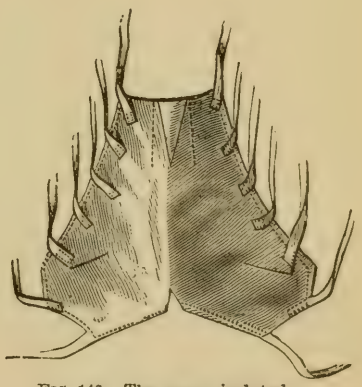


FIG. 146.—The same, isolated.

notched for the fold of the hock, and a gusset is made in its lower extremity for the fetlock. Four straps proceed from its superior border to be secured to the bandage of the leg, and the ends of the small tapes of its lateral borders are tied together in pairs in front of the leg.

(*g*) *Mechanical Bandages.*—This is the distinctive name of a class of dressings which are not only a passive means of protection to the parts upon which they are applied, but from which also proceeds a direct or positive action, by co-operating in the recovery of lesions, if indeed it is not the true operating cause which brings it about. Rollers and wide bandages some-

times act as mechanical bandages. But the name is more particularly applicable to certain more or less complicated apparatuses, whose special mechanical action has the effect of producing some defined therapeutical result. The metallic plate used in the reduction of some forms of hernia; the metallic spring apparatus used in applying pressure upon special regions, as, in orthopedic surgery, or in the reduction of fractures or dislocations, like those invented by Bourgelat, Brogniez, Defays, and others, are of this class, inasmuch as all of these possess the constituent properties which are understood to characterize the agencies belonging to the category of mechanical bandages.

These will be subjects for our consideration when we treat of the various conditions in which they are indicated.

CHAPTER IV.

ELEMENTARY OPERATIONS.

Under this term are understood those of a simple nature, as perhaps an incision or puncture, or the insertion of sutures, and other implicated manipulations, but which form the foundation and belong to the operative generalities of the domain of major surgery. They will be treated under the two principal heads of *division* or *dieresis*, and *reunion* or *synthesis*.

DIVISION.

This is a very common surgical step, of which the object is the separation of tissues from each other. Gourdon has recognized six principal modes by which to divide tissues, viz.: by incision, dissection, puncture, resection, ligature and cauterization. Varying, somewhat, from this view, and considering resection as an operation specially appropriate to bony structures, and ligature as adapted to the cellular tissues, and classifying cauterization as principally a means of puncture, we prefer, with Peuch and Toussaint, to reduce the consideration of these modes of division to three, viz.: incision, dissection and puncture.

A.—Incisions.

Any methodic division of soft tissues made with a sharp instrument is an incision. The basis of the majority of surgical operations, their purpose is to allow the escape of the contained fluid from a cavity, to enlarge the size of a wound, to make counter openings, to extract foreign bodies, to remove pathological growths, to destroy abnormal adhesions, to expose tissues to be operated upon or tumors to be removed, to facilitate the reduction of displaced organs, etc., etc. The bistoury, the scalpel, the sage knife and the scissors are the cutting instruments most commonly used for making incisions. Sometimes, however, the amputation knife, the tenotome, the herniotome, with lancets, or

even drawing knives, take their place. Drawing knives, however, are better adapted to excise the horny, or other similar hard structures, than to cut upon soft tissues.

FIG. 147.—Straight Bistoury.

FIG. 148.—Convex Bistoury.

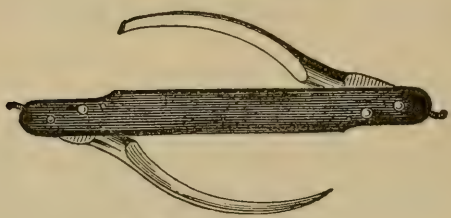


FIG. 149.—Concave Bistoury.

FIG. 150.—Blunt Bistoury.

FIG. 151.—Bistoury Caché (Castrating Knife for Females).

In form, the bistoury is either *straight*, *convex* or *concave*, and usually is pointed, but the use of blunt or guarded instruments is often indicated. The *bistoury caché* is also employed in some special operations. A bistoury is generally mounted with a single blade, though sometimes several blades are mounted together on one handle, and can be closed upon it in the manner of an ordinary pocket knife. But when strict antiseptic

rules are observed in the operations, the blade is held firmly on the handle, and cannot be closed.

Sage knives, which are much used in operations upon the foot, are but convex bistouries, single or double, curved upon their length, and, according to the disposition of the cutting edge, are called right, or left, or double. The blade is generally firmly

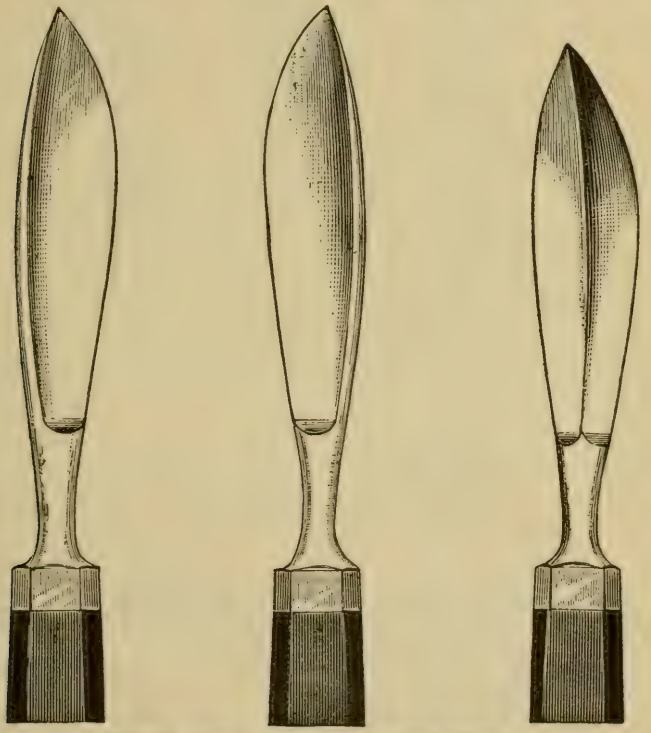


FIG. 152.—Right, Left and Double Sage Knives.

riveted in the handle, to render it more solid and better adapted to the incision of the comparatively harder tissues. When made to close as an ordinary pocket knife they are less solid, and more difficult to keep in good condition.

The scissors vary also in shape, and are sometimes straight, sometimes curved, and with either blunt or pointed ends. Besides these cutting instruments, directors are often used as guides to carry the knife in the desired direction, and obviate errors and accidents in operating. The bistoury is held in different

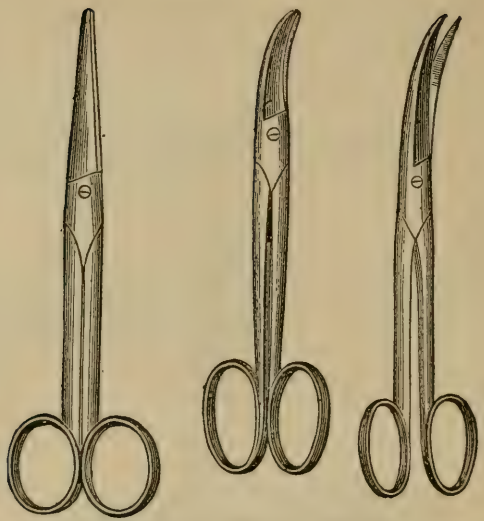
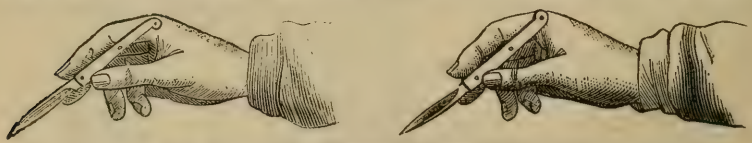


FIG. 153.—Various Shapes of Scissors.

positions, according to circumstances, as we shall proceed to point out and classify.

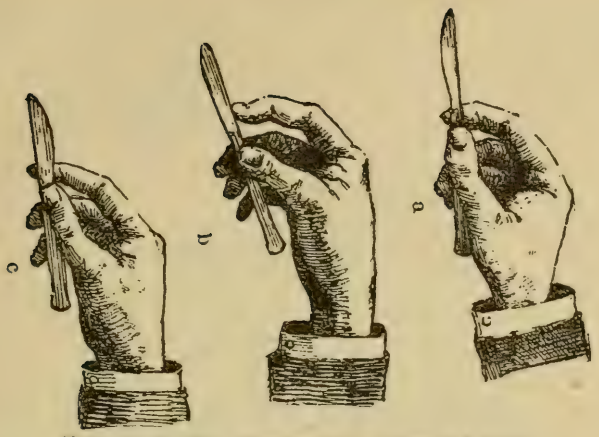
1st. *Held as a writing pen.*—That is, with the handle resting on the back of the hand, the thumb, index and medius finger on each side of the blade, the other two fingers resting on the skin.



FIGS. 154 and 155.—Bistoury held as a Writing Pen.

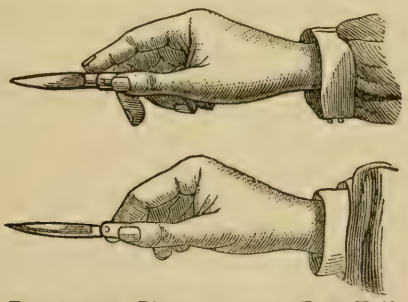
In this position the edge of the blade may be turned either downward or upward. The division mentioned by Gourdon, with the fingers extended or flexed upon the blade is scarcely, and at best but a variety.

2d. The instrument may be held *as the bow of a violin*, or the thumb on one side of the articulation of the blade, with the handle and all the fingers on the opposite side, the index on the back of the blade, the medius on the articulation opposite the thumb and the other two fingers on the side of the handle. None of the fingers must be allowed to divert the instrument from being carried horizontally upon the tissues. In this position the edge of the blade may be turned either downward or upward.



FIGS. 156, 157, 157*a*.—Bistoury held as a Bow of a Violin.

3d. The bistoury can be *held as a table knife.* The thumb and the medius being placed on opposite sides, at the junction of the blade and the handle, the index resting upon the back of the



FIGS. 158, 159.—Bistoury held as a Table Knife.

blade, the other fingers holding the handle in the hollow of the hand. As in the preceding positions, the edges of the blade may be either turned downward or upward.

Whatever position may be given to the instrument, it is to be held firmly, and with a steady hand. Sage knives are generally held by grasping the handle full in the hand, or, as when holding a bistoury as a table knife, sometimes with one hand only, and at others with both, according to the indications and the amount of firmness and steadiness required. The manner of holding scissors is already known. The only variation likely to be found

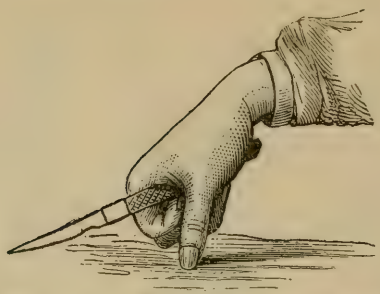


FIG. 160.—Sage Knife held with One Hand,

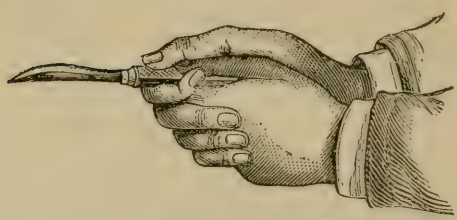


FIG. 161.—Sage Knife held with Two Hands.

needful, is that in some cases it is handier to grasp them from above and in others from below.

There are some general rules which are important to observe in performing the simplest operation. These relate to the condition of the instrument, to the preparation of the parts, and to the direction and dimensions of the incision.

The condition of the instrument must be such that the soft tissues may be divided with but little pressure. It must *cut* and not *tear*. Therefore, besides their state of thorough cleanliness, they must be very sharp and their edge entirely smooth and free of indentation, which would cause them to act as a saw and produce an irregular and ragged incision, more painful to the patient, and more difficult to heal. It has been recommended to dip them before using in oil or warm water, but these precautions can be dispensed with.

The region upon which the incision is to be made must be thoroughly cleaned, the hairs being clipped short, and sometimes even shaved. In these days of antisepsy, it is proper to soak it well, after it is washed, with some antiseptic solution. To make a clean incision, the skin must be well stretched with the hands, the instrument firmly held, and the division made by a steady move-

ment, to avoid the possibility of extending the incision beyond the necessary limits.

The direction and size of incisions require careful consideration. They must run as nearly parallel with the direction of the muscular fibres and the large blood vessels and nerves of the region as the condition of the part will permit.

Their direction should also correspond to that of the long axis of the part or tumor undergoing operation, and in such a manner that the retraction of the skin will not tend to separate the borders of the wound. Sometimes, according to the unavoidable natural motions occurring in a region, the normal folds of the skin should be considered. A vertical incision is always preferable, as more readily allowing the escape of liquids, pus or otherwise, which may have accumulated.

As much as possible, and generally, incisions should be made with a single stroke, and of the full length and depth required by the further steps of the operation. Besides diminishing the suffering of the animal, such an incision will greatly facilitate all the subsequent manipulations of the operator.

Incisions are made by four principal methods: first from without inwards; second, from within outwards; third by subcutaneous division; and fourth by the slicing, scraping or shaving method. In the first two modes the instrument may be turned in five directions.

(*a*) *Towards* the operator, by beginning at the farthest point and moving the instrument in the direction of his own person.

(*b*) *From* the operator, by reversing the former movement.

(*c*) From *left to right* and transversely, the instrument being held with the right hand.

(*d*) From *right to left*, or in the opposite direction, with the instrument in the left hand.

(*e*) From *above downwards*, in a vertical or slightly oblique direction.

Incisions from left to right and from above downwards are the most convenient, and for this reason the surgeon practices them as much as possible.

1st. *Incisions from without inwards.*—These incisions are carried from the surface of the skin towards the deep structures underneath. They may be made with any kind of bistoury, but the convex is to be preferred.

The skin should be well stretched by various movements of the hand, or of the operator, or his assistants, and held tense and smooth, unless it is already sufficiently expanded by the effect of the existing lesion underneath it. Then the operator, holding the instrument in the first or third position, carries the instrument, with the edges and the point turned downward, to the spot on the surface to be divided, and penetrating through the skin to the depth desired, completes the incision to its proper length.

This mode of incising the skin answers for the majority of cases, but there are others when the skin has to be divided carefully and by layers. Incisions are then made with the convex bistoury, held in either position with its edge downward, carried perpendicularly over the skin and often by repeated light strokes.

These two procedures answer when the part to be operated upon offers a certain solidity. Otherwise the incision can be made in a third manner, viz.: by taking hold of a fold of the skin, held at one end by an assistant, at the other by the operator, and completing it by a transverse section through the fold, made from the apex to the base. The objection to this mode of dividing is that the incision can never be thoroughly limited.

2d. *Incisions from within outwards.*—In contrast with those already considered, these incisions are made from the deep parts toward the superficial, and through the thickness of the skin.

The *Straight Bistoury* is here the preferable instrument, either alone or assisted by a guide or conductor, which may be the grooved probe, the director, or the finger of the surgeon. Either with or without, these incisions can be executed in various ways.

Without the Director.—With the bistoury held as a writing pen, with the blade turned upward, first the point of the instrument, and then the entire blade is thrust perpendicularly through the tissues; then lowering the handle of the instrument until it forms with the skin an angle of forty-five degrees, the instrument is moved in an oblique direction in such a way as to stretch and divide the skin, until at the end of the incision the bistoury is brought back to a perpendicular direction to complete the incision in a neat manner. This incision can be made *toward* or *from* the operator, according to the case. It will facilitate the action of the instrument if the skin back of the hand that holds it is stretched with the free hand of the operator.

Another manner of incision from within outward is to make a fold of the skin, as already described, and by pushing the straight bistoury through its base, and turning the edge, completing it by a single stroke upward to the summit. When an incision already existing must be enlarged, the bistoury, held in the second position, is introduced flatwise under the skin as far as is necessary; then turned to bring the edge upward and pushing the point through the skin by drawing the instrument outward, the flap of skin between the two openings is divided at one stroke.

A fourth procedure is known as the incision with flaps. It is principally used in amputations. With the left hand the surgeon grasps a fold of skin, pushes the bistoury held in the first position, but flatwise, through its base, and in drawing it out obliquely by a sawing motion cuts out a semi-circular flap of the required dimensions.

With the Director or Guide.—Incisions in this mode are made to remove compressions caused by strictures, or to establish a free exist to pus by a counter opening. Either the finger or the grooved probe or the director may be used as a guide to the instrument. In all cases there must already exist a natural or accidental opening to allow the introduction of the director. Several modes of procedure are employed according to conditions and objects in view. In one, the director being introduced into the tract to be enlarged, as far as the point where the incision must end, the bistoury, held in the first or second position, with the edge turned upward, is made to slide into the groove of the director, forming with it an acute angle, and pushed in its whole length, dividing the tissues until it reaches the end of the groove, when it is withdrawn in the perpendicular position. A second mode is to carry the bistoury flatwise alongside the director, and when reaching its end to turn the instrument with the edge upward, first thrusting the point through the tissues and tegument, and completing the incision by withdrawing the bistoury outward and toward the operator. In a third procedure, which is that of making counter openings, the probe or director is introduced into the wound, and at its deep end, to push toward the skin until it raises it from the inside or can be felt through it; an incision from without inward is then made at that point, and the director being exposed, the bistoury is engaged in its groove and pushed alongside, dividing the tissues at will in length and in depth, and establishing

a broad communication between the original opening and the one just formed. By using the sharp end of *an* S *probe*, passing it alongside the director previously engaged, and pushing it through the side, the making of the incision from without inward may be avoided, as described above, and the groove of the S probe may be used as that of an ordinary director.

Sometimes, however, when the original opening allows it, the finger is introduced into it and used as a conductor. In this case, a blunt bistoury is preferable, as less dangerous to the operator than the straight instrument, or the curved form may be used. This may be made to slide with the back of its blade, or again flatwise, along the palmar face of the finger until the bottom of the wound has been reached, and then turning the knife, the tissues are divided by carrying the bistoury either toward or from

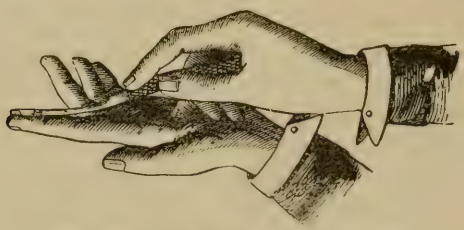


FIG. 162.—Using the Finger as a Director.

the operator. This procedure is more applicable when the fistulous head is not deep, but it is preferable to the use of the ordinary director as being a much better instrument of diagnosis, and safer as a director of the bistoury.

3d. *Subcutaneous Incisions.*—The usefulness of this mode of dividing tissues is best demonstrated by its application to cases of tenotomy and myotomy, or the puncture preceding the injection of tincture of iodine according to some methods. It requires special instruments, made with narrow blades or with fine trocars, which, when introduced through the skin, leave a very small opening, the division being made under the ligaments, with special care to avoid its division beyond the point where the instrument has been introduced. Suppuration seldom follows this operation if it has been properly performed, and, accordingly, the cicatrization is very rapid; the great advantage obtained by this mode of incision cannot be overlooked.

4th. *Incisions by Slices—Scraping or Shaving Incisions.*—These incisions are made by dividing the tissues in successive layers. Three varieties of operation are practiced, differing according to the density of the tissues acted upon. In the first, which is applicable to hard structures, the bistoury, or, preferably, the sage knife is required. The instrument is held full in the hand, as a table knife, or, again, as the bow of a violin, and is passed flatwise over the surface of the tissues, and layers of various thicknesses removed from it; and sometimes the tissues are sufficiently hard to require the strength of both hands for the management of the instrument.

FIG. 163.—Sharp Tenaculum.

In a second mode, applicable to soft tissues, a convex bistoury and a pair of forceps or a sharp tenaculum are necessary. Raising with either of these a thin layer of the tissue to be divided, the bistoury is carried slightly flatwise over the surface and a piece of it is cut, scraped, or shaved off, the operation being repeated until the desired depth has been reached.

A third mode is applied in cases of growths which are to be cut off at their base. To do this, the growth is raised as much as possible, by means of the forceps or tenaculum, and the amputation is accomplished with a few sawing movements of the instrument.

The forms which incisions may receive are of two principal kinds—the *simple* and the *compound.*

Simple incisions are those which are generally made with one stroke of the bistoury, and generally from without inward, and are either *straight* or *curved.* The *straight*, or simple, are indicated for the exposure of regions, the opening of abscesses, etc., etc. They are not as applicable to the removal of tumors, especially of those which have large bases. The curved incisions vary in their circular shape, and differ also from the straight in the *modus operandi*, as they require a stretching of the skin to be made in various directions, as that of the bistoury is changed over the cutaneous surface.

Compound incisions are formed by the union of several simple incisions, their number varying much, but they may be reduced

to the following kinds: the T and V shaped, the crucial, the elliptic, and the semi-lunar. The branches of these compound incisions are made in the same manner as for the simple kind; when two incisions are to meet at a given point, the second one must be made, not to begin, but to terminate at that point; when two incisions are to unite, one above the other, the lower one is to be made first, to avoid the flow of blood from the upper, which would cover and conceal it; and when two incisions are to meet at their extremities, it is proper that the ends of the second incision should start a short distance beyond the commencing point of the first, and terminate with a similar space from the end of the first incision. In other words, the junction of the extremities of the two incisions must never be by a perfect acute angle. The angle must always have a slight prolongation formed at one extremity, by the extension of one, and at the other by that of the other incision. These rules are not absolute, but may be changed as circumstances may require.

In the *T-shaped* incision, a straight cut is carried perpendicularly upon the middle of another. In the *V-shaped*, there are two straight incisions meeting at an acute angle by one of their extremities, this angle, as we have just said, having a small prolongation on one of its lines at their junction. The V-shaped incision may open in every direction. Sometimes the two incisions are made to meet at a right angle, to form the *L-shaped* incision.

In the *crucial incision*, two straight cuts are made to meet at their middle, usually at a right, sometimes at an acute angle, forming an *X-shaped* incision. This is made in three steps, first, a simple straight cut; second, the first part of the second incision as in the T-shaped form, and third, the second part of the second incision ending, not beginning, at the point of junction of the incision made in the first two steps, and in such a manner as to be the continuation of the incision made on the second step. This incision may also be made in two cuts, when the skin is hard and adherent to the deeper tissues, by making the second incision with one stroke of the knife, passing at the middle of the first.

The *elliptic* incision is made with two curved cuts, so united at their extremities as to leave between them an elliptical space. The *semi lunar* or *crescentic* incision is formed by two curved ones, the circumferences of which are turned in the same direction, leaving between them a form like that of the new moon.

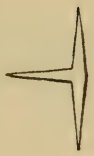


FIG. 164.—T-shape Incision.

FIG. 165.—V-shape Incision.

FIG. 166.—Crucial Incision.

FIG. 167.—Semi-Lunar Incision.

FIG. 168.—L-shape Incision.

FIG. 169.—X-shape Incision.

FIG. 170.—Elliptic Incision.

B.—DISSECTIONS.

Dissection is the separation of the cellular tissue from the various parts to which it is united. The scalpel, the bistoury and the scissors are among the necessary instruments, sometimes replaced or assisted by the fingers or a strong director. With the scalpel, or the bistoury, the handle is also utilized, and frequently the blunt extremity of the scissors, while again in some cases the cellular connections are separated with the fingers or the blunt end of a director. To these instruments are added forceps, either the common dissecting, or the bull-dog form. Three procedures are involved, viz.: the *free* dissection, the *limited*, and the dissection by *slices* or *shavings*.

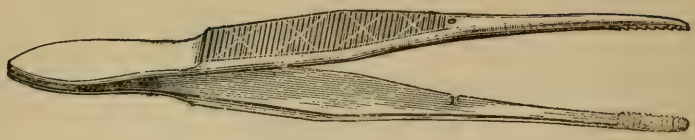


FIG. 171.—Dissecting Forceps.

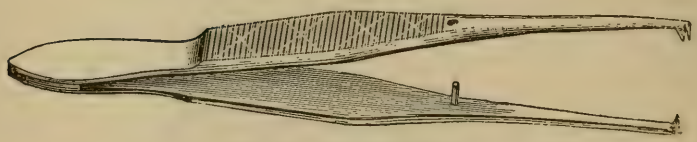


FIG. 172.—Bull-Dog Forceps.

(*a*) *Free dissection* is that of a flap of skin from the tissues beneath, to which it is only slightly adherent. Holding the skin with the fingers, or the forceps, with one hand, and having the bistoury or scalpel in the other, the skin is raised as much as possible and separated from the other tissues with a single stroke of the bistoury, held as a pen or as a violin bow, the operator drawing it towards him as much as possible. In the dissections of flaps of skin, as those in the V, the T, the crucial, and the crescentic incisions, the strokes of the bistoury extend in length as they approach the base, or the adherent portion of the cutaneous flap. In the straight or elliptic incisions, on the contrary, the strokes are longer at the beginning. When the cellular tissue is very loose, its separation from the skin is made with the fingers or the blunt end of the scissors. This mode, called *enucleation*, is often employed for some special forms of tumors, as the fibroid, or fatty.

(*b*) *Limited Dissection.*—The steps of this process are the same as those of the preceding, excepting that the surgeon proceeds by small strokes in order to avoid going too deeply into the tissues, and leave the skin of a sufficient thickness.

(*c*) *Dissection by Slices or Shavings.*—The skin being divided, and the subcutaneous tissues raised with the forceps, the bistoury, held flatwise, excises horizontally each layer of the structure by a sawing movement.

C.—Puncture.

Properly speaking, this is a simple, special operation, designed to penetrate into hollow parts, to explore the nature of tumors, to

examine the contents of natural cavities, or to provide for the escape of gases or fluids. It is, therefore, a solution of continuity of small dimensions, constituting often the first steps of an incision, but which forms also an essential operation. It can be performed with various instruments, as the lancet, the straight bistoury, the trocar, the exploring needle and their adjuncts, the aspirator, and the actual cautery.

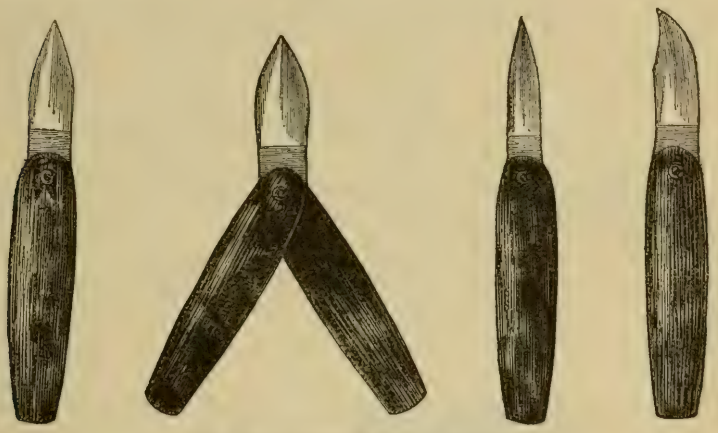


FIG. 173.—Various Shapes of Lancets.

Puncture with the Lancet.—In form and shape the lancet greatly varies, but in general it may be considered as a compound bistoury, with a pointed and two-edged blade. The point may be either quite wide, or very acute, and is sometimes curved, with one edge convex and the other concave.

To use the lancet, the blade, open at a right angle with its handle, is held between the thumb and index finger, while the

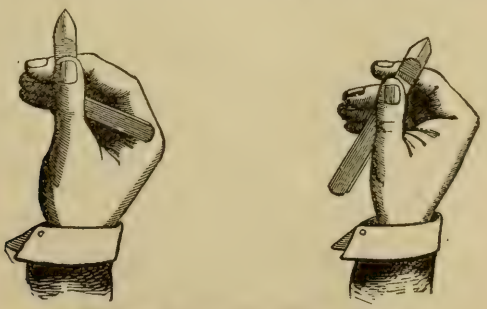


FIG. 174.—Manner of holding a Lancet.

handle rests on the back of the hand, with the fingers slightly flexed. The joint, brought close to the skin, and perpendicular to it, is thrust by the extension of the fingers through the tegument and tissues underneath and then drawn out perpendicularly, unless it is desirable to increase the size of the incision, when the division is made by extending the incision from within outward.

Puncture with the Straight Bistoury.—The bistoury, for this purpose, must be finely pointed and sharp. Held as a writing pen, with its edge upward or downward, or as a table-knife, according to the thickness of the tissues, and its action limited by having the fingers at a given distance from the point, it is pushed perpendicularly and more or less rapidly at once to the necessary depth. It is then drawn out, unless the incision is to be enlarged, which is done by a motion from within outward by the blade. Sometimes the instrument is pushed into the tissues in an oblique, instead of a perpendicular direction, when it is not desirable to have communication between the opening of the skin and the one directly beneath it. This constitutes the first step of the subcutaneous incision.

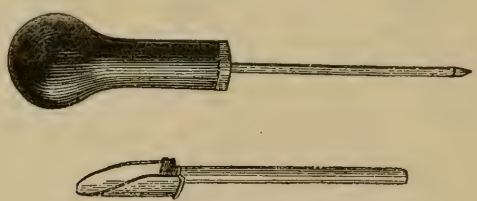


FIG. 175.—Trocar and Canula.

Puncture with the Trocar.—This instrument is composed of two parts. A rod, secured to a firm handle at one extremity and terminating at the other in a tri-faced point, is one; this rod fits into a canula, blunt at one end and having at the other a cup-shaped flange, which is the other part. The canula is long enough to receive the entire length of the rod, except the tri-faced point, which projects beyond it. The two parts are fitted closely together.

Trocars are of various size and form, being both straight and curved. That which is used for hyovertebrotomy is the longest of all; those used for rumenotomy are quite large in diameter; the enterotome is, on the contrary, quite small.

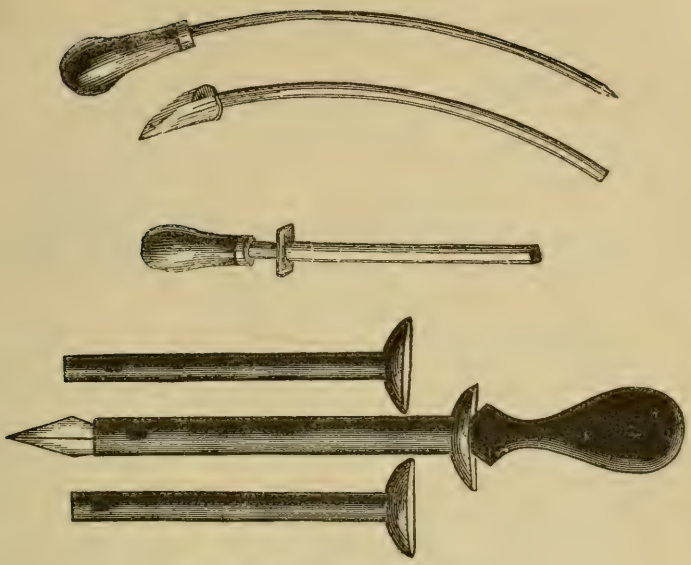


FIG. 176.—Various Forms of Trocars.

To puncture with the trocar, the operator will assure himself that it is in good condition, and that the rod can readily be withdrawn from the canula when necessary. Holding the instrument in such a manner that the handle, grasped by the three fingers, rests in the palm of the hand, the thumb is applied on the canula near its point of union with the handle, and the index extended on the outside of it, to limit the play of the instrument; the trocar is pushed through the tissues in a perpendicular direction, and until a sensation of resistance is no longer felt. When introduced, the canula is held in place with one hand, while with the other the rod is slowly drawn straight out, or by a slight rotary motion.

If the design of the operation has been the evacuation of the liquid contents of a tumor, as the fluid escapes the growth diminishes, and it becomes necessary to insert the canula further in the cavity or turn it in different directions, to ensure the removal of the entire contents. Yet it is necessary to be careful not to press the orifice of the canula against the walls of the sac, a condition likely to prevent the escape of the fluid.

To remove the canula, moderate pressure is applied with one hand on the skin around the seat of the puncture, while the other

withdraws the instrument by its *pavillon*, drawing it in a line parallel to the division in which it was introduced.

Exploring needles, or trocars, which are but small directors with a lanceolate blade at one end, and a small groove on one side, are also used for making punctures, and their adaptation as

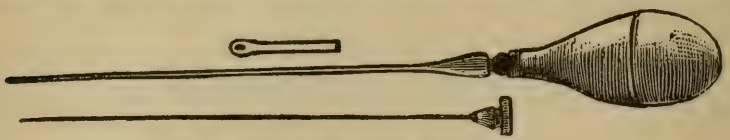


FIG. 177.—Exploring Needles.

very small trocars, with aspirators (principally that of Dieulafoy) find frequent use in our surgery. These instruments have already been considered in the chapter upon surgical diagnosis.

The Puncture with the Actual Cautery.—The conical cautery is the one used in this mode of operation. It varies in diameter and in length. The instrument is heated to a white heat, applied perpendicularly upon the skin and pushed in until the sense of resistance is no longer felt, when it is withdrawn. The condition of white heat of the instrument is of great importance. Though apparently an act of great severity, the operation finds numerous applications in our surgical practice, principally for the puncture of deep-seated cold abscesses. It has great advantages over the puncture with the bistoury, inasmuch as there is no hemorrhage to fear from its use; because the opening made by the cautery remains unclosed a longer time, and because the inflammation is modified in its nature, and the process of resolution thus assisted by the caloric thrown in.

The use of local anesthesia, by the injections of cocaine, will remove from this mode of puncture the rough side of its application by rendering the operation entirely painless.

REUNION.

This term signifies the readjustment and consolidation of tissues which had been disintegrated and divided—otherwise, simply the reuniting of separated parts, and their restoration to a normal condition. This process is otherwise referred to as that of *cicatrization*, a natural property of organic tissues, which, though it may be aided and guided by the surgeon, can be controlled by

him only to the extent of preventing accidents and maintaining natural conditions. The processes, the order, and the rapidity of the formation of cicatrization are not the same with different tissues, and certain distinctive terms have therefore been adopted by which to denote the modified ways by which the purpose of nature is effected. Thus we have *immediate reunion* or *adhesive inflammation* or *union by the first intention*, by which separated parts solidify upon simple contact, as varying from *union by the second intention*, or by granulation and suppuration; followed by *union by the third intention*, when, together with the processes of the second intention, there is added one of mortification and the elimination of dead structure. This subdivision accords strictly with the order of nature, as it may be constantly observed, the phenomena of separation involving a regular gradation of detail in the active forces employed in the recuperative effort, from the simplest and most efficient in the *union by first intention* to that which is, in fact, a struggle between the elements of growth and preservation and the tendency to dissolution and death, as exhibited in the third degree.

Before proceeding to the direct discussion of the means used to assist the *vis conservatrix* in the reunion of divided parts, there are some general considerations of which the surgeon must never lose sight. They are not of the less importance because they are matters of an obvious and secondary character, and refer mainly to what may be termed matters of minor detail. Where immediate reunion is looked for, the wound must be fresh and clean, and entirely free from clots of blood or foreign substances. The edges must be smooth and even, and if there are any ragged portions they must be carefully excised. In addition to this, where there is a granulating surface the granulations must be carefully inspected and their healthiness assured, and the surgeon must search carefully to ascertain that there are no fistulous tracts present. In any case the hair must be clipped short around the edges, the skin thoroughly washed, and, what is a point of primary importance, the exact coaptation of the opposite edges carefully ascertained and secured.

The means employed to maintain the contact of the edges of a wound, and assist in its closure are, according to Gourdon, of four kinds—*position*, *uniting bandages*, *adhesive plasters* and *sutures*.

A.—Position.

This is more a preparatory step toward obtaining reunion than a true means of securing it, and to have its full effect and assure all its benefits, must be accompanied by the judicious application of plasters or bandages. By *position* is understood such an attitude of the patient as will tend to keep in coaptation the sides of the wound, as opposed to a posture which would, if left unguarded, disturb the immobility which is indispensable to the completion of a symmetrical union. The natural restlessness of the patient under the circumstances, even irrespective of the ordinary liability to the slighter causes which divert his attention and render immobility impossible, forbid the idea of entire passivity. And yet there are some cases where it is possible, or at least must be attempted. This may be illustrated by the hypothetical case of a lacerated wound, forming a V shaped flap of skin, with its base turned upward. By taking advantage of this condition, and keeping the apex of the V downward, the *position* of the flap will itself assist in closing the wound, the edges having a natural tendency, from the contractive character of the fibres, to form, and to maintain the desirable contact. But if, on the contrary, the flap has its base turned downward, the difficulty of keeping it in its proper position will be greater, proportionately to the tendency of the edges of the flap to drop away from those of the skin. Taking advantage of the *position* of this peculiar wound, and assisting it by the application of bandages or other means, will materially facilitate the closure of the wound.

B.—Uniting Bandages.

Though these are not so frequently required in veterinary as in human surgery, they are very effective in bringing together and retaining the edges of wounds, especially in the extremities, where in both transverse and longitudinal wounds they fulfil their purpose very satisfactorily, especially where only the skin is involved. If the injury extends to the muscular substance, however, they are both more difficult to apply, and less serviceable in their effects. In wounds of a transverse character, two bandages of a length equal to that of the injured leg, and as wide as the great axis of the wound, are required. One of these is divided into

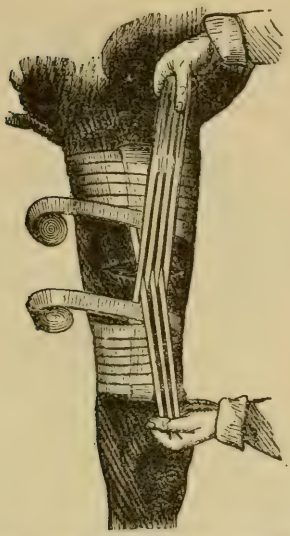


FIG. 178.—Bandage for Transversal Wound.

three or four strips in one-half of its length, the other having in its middle an equal number of longitudinal slits, smaller than those of the first, these two being fixed parallel to the axis of the leg, one above the other below the wound, by several turns of rollers, and by passing the strips of one through the corresponding slits of the other, the edges of the wound will, by opposite traction upon the bandages, be necessarily brought together and supported in that position (Fig. 178.)

The same method answers for longitudinal wounds, though simpler in structure; this bandage, consisting of a single band of a width equal to the length of the wound, and prepared with strips and corresponding slits, as just described, at a distance of about three-quarters of the circumference of the leg. Thus prepared, and compressive pads placed on each side of the wound, the bandage is manipulated as in the other cases, and when it is all properly adjusted, is further secured by rolling it around the leg over the strips (Fig. 179.)

C.—Adhesive Sticking or Agglutinating Plasters.

These descriptive terms refer either to certain special mixtures which are applied either directly, and alone upon the solutions of continuity, or spread upon linen, in the form of the ordinary

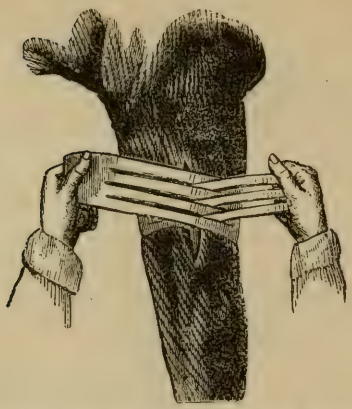


FIG. 179.—Bandage for Longitudinal Wounds.

surgeon's plasters. They are better adapted for use, with the smaller, than with the larger animals, answering all the requirements with the former class. They are composed of various ingredients, differently combined, such as black pitch, with resin, venice turpentine, etc., and oils, to improve their flexibility, and aid their curative qualities.

Venice turpentine, alone, is sometimes spread over the bandages, also a mixture of tar and Burgundy pitch. Pitch, alone, when melted and mixed with cut oakum or tow, forms a good adhesive mixture. The ordinary adhesive, or diachyton, or lead plaster, used in human medicine, is of great value in the surgery of small animals, and we have used it with great satisfaction with both large and small patients, applying it in long strips, rolling them around the affected region in two or three thicknesses. Collodion has also been highly recommended. Either alone, or applied with thin linen, or what is better, with wadding, it forms over the surface of a wound, not only an adhesive plaster, but also a protective dressing. Plasters are, in some cases, used alone as means of reunion, and in the treatment of fractures, they form a powerful adjunct in controlling the displacements of fragments of bone. They are, however, also frequently used to reinforce other means of reunion, and especially deep sutures.

D.—SUTURES.

In all the category of surgical detail, there is nothing so effective, or indeed indispensable, as the suture, properly applied, for

the retention of breaches of continuity, whether the sewing be done by means of linen or silk thread, animal fibre, metallic wire, needles, pins or other instruments. By no other means can the parts be held in the necessary coaptation to insure a perfect reunion. The suture is available for various purposes. Besides contributing materially to the coaptation of the edges of a wound, and thus aiding to secure a cicatrization by first intention, it prevents the contact and introduction of air into a wound, arrests and prevents hemorrhage, keeps in place lacerated fragments of deep wounds which could not be controlled by bandages alone, assists in the closure of artificial openings, such as may take place in the walls of the abdominal cavity, and prevents the escape of any portion of its contents, and assists in the closing of natural openings. But, though principally useful in effecting the objects enumerated, the essential indication of the suture appears in the reunion of solutions of continuity, and, particularly, in regions where the natural movements of the parts tend necessarily to prevent the borders of the wound from remaining in undisturbed contact, for a period sufficient to obviate the danger of serious blemishes of cicatrization. But while the suture is of no less advantage in fresh injuries, it is also indicated as well in suppurating wounds, with the precaution of leaving room for the free escape of pathological secretions.

Sutures are contra-indicated, when a wound becomes the seat of extensive inflammation, or occupies a broad surface, or is irregular, or accompanied by loss of tissue; or when the parts are the seat of severe contusion, or contain foreign bodies or mortified tissues in their depths. There are other cases also, where their employment is contra-indicated, as when their object is likely to be defeated by the uncontrollable movements of the patient. Causes of failure may also sometimes be found in the irritation arising from the material of which the suture is formed, cutting its way loose. By this accident, a wound which, if not interfered with, would have left but little if any cicatrix, and would have required but a short time to heal, becomes transformed into a large, ugly, granulating surface, that is likely to leave a comparatively bad looking cicatrix in the end.

The application of these retentive stitches falls under the general rules relating to the *disposition of the edges of the wound*, and the *special placing of sutures*. In reference to the first point,

the first consideration to be noted is, that the wound must, of course, be thoroughly cleaned, and free from blood or foreign bodies. Then the borders of the wound must be fresh, or, if old, blackish, or beginning to granulate, must be slightly excised by thin scraping, and the edges brought as closely in contact as possible.

To apply the suture, the needle is to be held and used precisely like an ordinary sewing needle. If the skin is thick enough to require it, a thimble can be used. Sometimes special needles with handles are made, and sometimes forceps may be needed to grasp the needle, and push or pull it through the integument. The needle should pass through the skin as nearly perpendicularly as possible, since, if introduced too obliquely, the tractions upon the skin may be sufficiently uneven to involve the possibility of tearing out the stitch. In placing the suture, nerves, tendons and blood vessels must, of course, be avoided. The suture should embrace a good hold of the skin to secure a greater traction and better approximation of the parts; the distance between the stitches must be such that no gaping can take place; they must be disposed at regular distances apart. When the needle is introduced from without inward, the skin is raised with the fingers of the left hand, or, better, with a forceps; if introduced from within outward, pressure is to be made upon the skin with the fingers or the blunt blade of a pair of scissors, near the point of exit of the needle.

Generally, the suture is begun at the middle of the wound, in which case the edges are made to meet more accurately and regularly. This rule, however, will find numerous exceptions. All the stitches should be placed before any are tied, and they must be tied only sufficiently tight to keep the edges together; otherwise they may cut through the skin. If not sufficiently tight the wound will be left gaping and cicatrization will be interfered with. The knots ought to be placed as much as possible on one side of the wound and towards the most dependent part, to avoid their being soiled by the suppuration.

The material used for sutures varies much. Strong linen thread, silk, metallic wires of silver, lead or tin, and in some cases narrow and thin elastic cords or bands are used, according to the circumstances. Metallic wires have the advantage of being less irritating, and can remain in the thickness of tissues without giv-

ing rise to excessive inflammation or ulceration if the swelling should be extreme. Elastic cords or bands have an important advantage in their property of yielding to the inflammatory swelling, as it develops itself while avoiding dangerous or unnecessary traction.

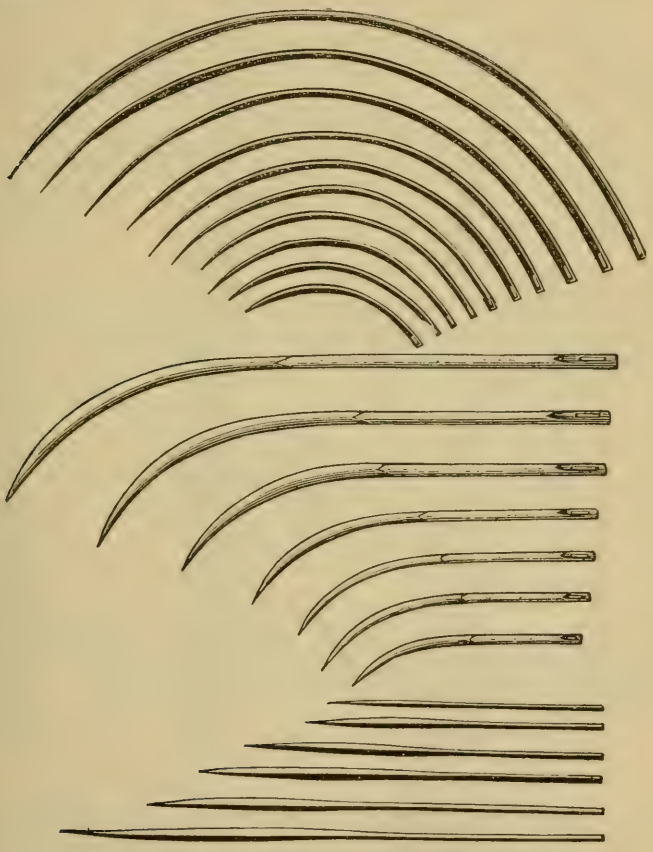


FIG. 180.—Various Sutured Needles.

Suture needles are made in countless forms and numbers, straight and curved, and of different lengths and dimensions, but having, all of them, flat points. When metallic sutures are used, their extremity is grooved to receive the wire in such a manner that its double thickness will not interfere with its passage through the skin.

FIG. 181.—Grooved Needles for Metallic Sutures.

FIG. 182.—Trelat's Needle.

FIG. 183.—Riverdin's Needle.

FIG. 184.—Simpson's Needle.

Some needles are armed and protected with handles, as those of Trelat, of Riverdin, and of Simpson. Sometimes their lanceolated part has the eye pierced in its center; in others, the eye is merely a notch, closed by a repulsor, moved by sliding through the handle. Generally, the hand is sufficient to push the needle through the skin, but at times, as has been mentioned, forceps or needle-holders are necessary, such as the needle-holder of Matthieu, an ordinary forceps or an ordinary pin-holder. The common wire dressing pin is also included among suture implements,

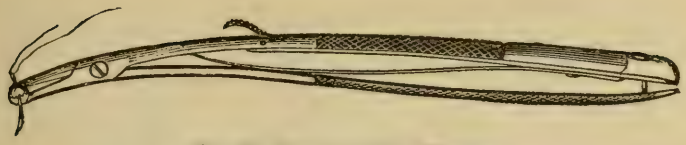


FIG. 185.—Needle Holder of Mathieu.

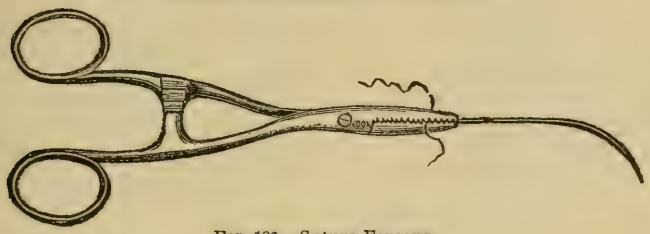


FIG. 186. - Suture Forceps.

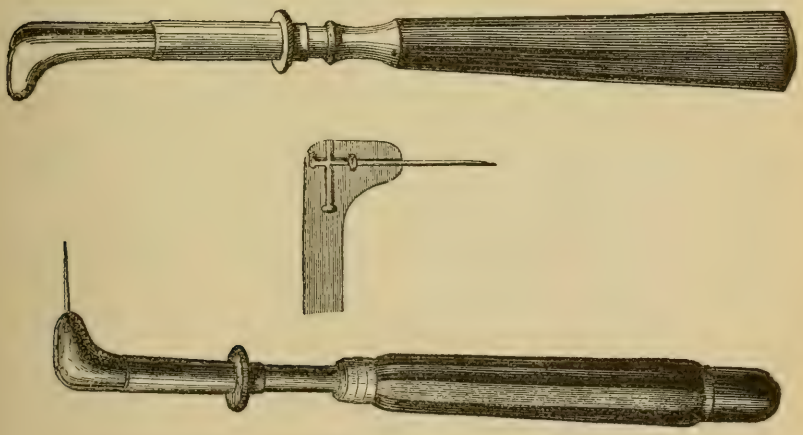


FIG. 187.—Needle or Pin Holder.

but is not always efficient from lack of rigidity, when a stronger and less flexible implement becomes necessary.

Sutures are of many kinds, some being superficial, others deep, and otherwise classified, according to the requirements of their application, into *single*, as when the thread or wire alone maintains the reunion, or *compound*, when it requires other and accessory means, such as needles, pins, quills, etc., etc.

1. *The simple or interrupted suture* (Fig. 188) is formed of distinct stitches between the borders of the wound, each being tied

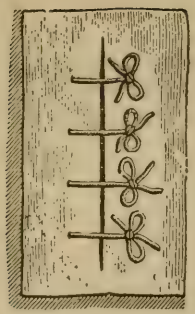


FIG. 188.—Simple or Interrupted Suture.

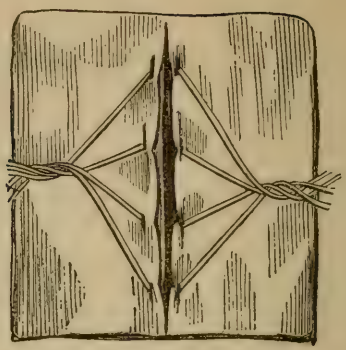


FIG. 189.—Looped Suture.

separately. It is made in two ways. By a first procedure, with a needle holding a long thread, the surgeon holding both edges of the wound, passes it through both at once, cutting the thread and making each stitch entirely distinct, and tying then only when they are all in place. He begins with the center stitch.

In the second procedure, a separate thread is prepared for each stitch, having a needle at each end, which is passed through the skin from within outward, and, as before, each stitch is tied independently of the others. Often, only a single needle is used, making the first half of the stitch from without inward, and the second half from within outward.

This suture is used for recent wounds, and those in which there is extensive laceration of the integument.

2. *Looped Suture* (Fig. 189).—This is an interrupted suture, in which the threads, instead of being tied up separately over the wound, are twisted together on each side, without being tied, in order that each thread may be removed independently of the others, if necessary. The cords are then twisted together, and sometimes tied and sometimes not.

It was formerly recommended for intestinal wounds, and is but little used at the present time.

3. *Uninterrupted or Glover's Suture* (Fig. 190).—This is a continuous suture, of which the stitches successively cross the wound from both within and without. In making it, the thread is knotted at the end, and the needle pushed through the skin at one extremity of one of the borders of the wound, from without inward, and then directly opposite it through the other edge, brought to

the first in crossing the wounds obliquely, and this is repeated until the lower end of the edge, opposite to that at which the suture was begun, is reached, when the thread is stopped by a knot. Before securing the last stitch, care must be taken to remove any possible wrinkles between the stitches.

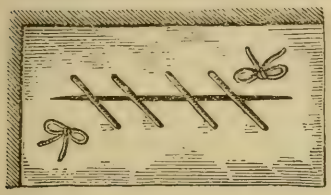


FIG. 190.—Glover's Suture.

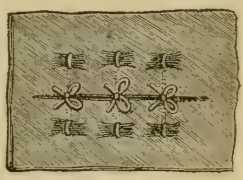


FIG. 191.—Dossiled Suture.

4. *Dossiled Suture* (Fig. 191).—This is a variety of interrupted suture, in which the thread is doubled, and at one end carries a little ball or dossil of lint or oakum. Passed through one edge of the wound from without inward, it is brought outside of the wound, and cut the necessary length. Another similar thread is passed through the other border in a similar way, and, when cut, both threads are tied together in the center of the wound.

This suture is often used for the purpose of holding in place the substances (wadding, oakum, etc.) that may be placed in the wound, or to prevent the return of a hemorrhage. It is a strong adjuvant of other hemostatic measures.

5. *Quilled Suture* (Fig. 192).—This is formed by a series of interrupted stitches, supported on each side by a short piece of quill or wood, or metallic pin, which must be longer than the great axis

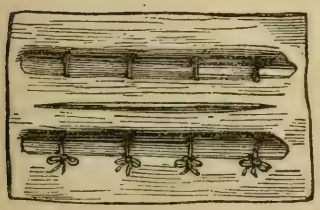


FIG. 192 - Quilled Suture.

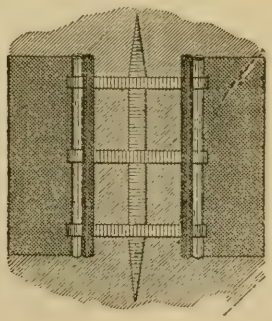


FIG. 193.—Suture with Adhesive Bandage.

of the wound. To apply it, a double thread, with the ends knotted, is passed through the edges of the wound, and several stitches made in succession, as in the regular simple interrupted suture. When these are in place, the support (quill, pencil or otherwise) is passed through the lap of each double thread on one side of the wound. Drawing this first quill close to the skin, the threads are separated, and, between them, a second quill applied on the other border of the wound, and secured in place by a knot.

This suture is recommended for wounds of the abdomen. Peuch and Toussaint recommend it after the removal of mammary tumors in bitches. Sometimes elastic cords are used, in preference to ordinary threads, as being less putrescible, and yielding better to the inflammatory swelling, etc.

Director Degive frequently employs the *elastic suture with adhesive bandages* (Fig. 193).

Two adhesive bandages, of dimensions proportionate to that of the wound, are glued on each side of it. These carry near the border, in the neighborhood of the edges of the wound, small holes, through which elastic rings are passed. These rings represent the threads used in the other mode of procedure, and through these rings the quills or pins are placed, which will rest on the outside of the bandages and keep them in place.

FIG. 194.—Single Pin Suture.

6. The *single pin suture* is a simple operation for small wounds, commonly used as the last step of the operation of bleeding, and by which both edges of the wound are brought together with a pin, and secured by a special double loop or hitch called the bleeding knot.

7. *Twisted Suture* (Figs. 195, 196).—This is frequently used for wounds of the eyelids or of the nostrils. It consists in placing through the borders of the wound as many pins as may be necessary, and holding them by twists of thread. Ordinary pins are generally used in veterinary surgery.

The pins are secured in different ways. In one case, the twists are so made as to form a series of figure 8s, placing them two or three times successively, first around the pin at one extremity of the wound and repeating the movement with each pin. In another way, instead of making a figure 8, the threads are turned around the pins at each stitch, surrounding all with a circular thread.

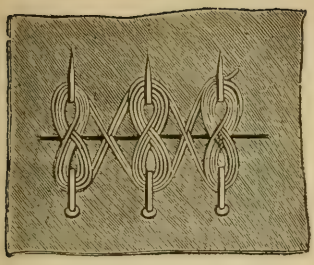


FIG. 195.—Twisted Suture.

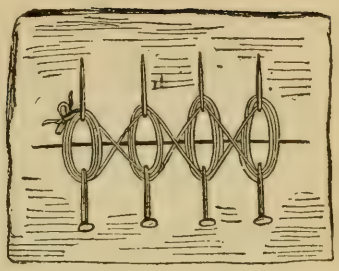


FIG. 196.—Another.

Some veterinarians, in making this compound pin suture, prefer the use of elastic rings to that of the circular or figure 8 threads. We have personally used these rings with very satisfactory results.

8. *Zigzag Suture* (Fig. 197).—This is a continued suture in which the thread is made to cross and re-cross from one border of the wound to the other. The procedure is as follows: a needle carrying a long thread is passed through one edge of the wound from without inward, and through the other in a straight direction from within outward. Starting with the same thread, a second stitch is taken at some distance from the first, and on the same side of the wound on which the first was ended, a second stitch is made by passing the needle from without inward, and back from within outward, to reach the side of the wound where the first stitch was started at an equal distance from it. The remaining stitches are, of course, made in the same manner.

This suture has been recommended for the treatment of umbilical hernia in solipeds.

9. *Suture of the Furrier.*—This is performed with a needle and a long thread, which is alternately passed through the edges of the wound from without and from within. It is also a continuous

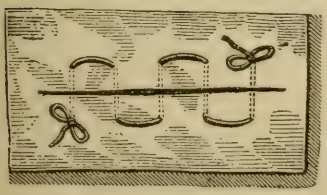


FIG. 197.—Zigzag Suture.

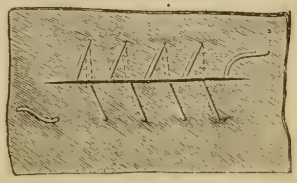


FIG. 198.—Suture of the Furrier.

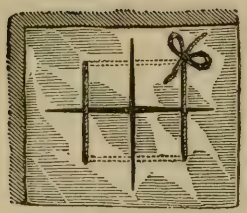


FIG. 199.—T Suture.

FIG. 200.—X Suture.

suture, in which the coaptation of the borders of the wound is regular and exact. It is principally applicable when the borders of the wound have a tendency to overlap each other.

10. *T Suture* (Fig. 199).—This is the peculiar stitch used to bring together the borders of a T or crucial incision. A thread is used with a needle at each end, each of which is passed through from without inward, in one of the angles of the T, and brought from within outward beyond the transverse incision of the T when being unthreaded and laid aside. The suture is completed by tying the two ends of the thread together.

The same suture could be made with a single needle.

The same procedure is required for the crucial incisions.

11th. *X Suture* (Fig. 200).—This suture, which is recommended after spaying sows, is made by taking a stitch through both edges at once, and carrying the thread obliquely across the wound, starting the second stitch on the same border of the wound as the first, and finishing in the same manner; the thread is then again passed across the wound, and the ends tied together.

12th. *Metallic Sutures.*—These do not differ from the sutures which we have considered, excepting that metals are used instead of thread or silk. They are applied like the others, and secured in the same manner, by knots or by twisting their ends together.

The period for the removal of sutures depends upon many circumstances, and varies according to the nature of the tissues involved, their thickness, and the species of the animals operated on. In horses and in dogs, suppuration occurs more rapidly than in ruminants or swine, and on that account the sutures cannot be allowed to remain as long, without giving rise to the formation of pus. Moreover, in regions where cellular tissues and blood vessels are abundant, the pus is usually formed more rapidly than in those

of the opposite formation, and consequently sutures must be removed earlier. On general principles they should be taken out by the fourth or fifth day, or even sooner, if indications of complication due to their presence are manifested.

In removing sutures, it is necessary to proceed cautiously, in order to avoid breaking any adhesions that may have been formed.

As a general rule, but one should be detached at a time, beginning at the least important point. The threads and needles should be cut close to the side opposite to that on which they are to be extracted; they must be carefully cleaned of crusts or dried pus and any roughness whatever, and the skin should be carefully held down as they are slowly drawn out. If the adhesion seems at any points to be too light, the sutures must be left in a few days longer. The application of adhesive mixtures, or of collodion, will strengthen a weak cicatricial tissue.

When a suture has been applied, as well as when it has just been removed, it is sometimes necessary, in order to prevent the animal from biting or rubbing the cicatrix, to bring the cradle or the side bar into requisition.

CHAPTER V.

OPERATIONS ON THE SKIN AND CELLULAR TISSUE.

CAUTERIZATION.

The theory of the cautery is the irritation and disorganization of living tissues, either by the immediate contact of heat or of chemical substances, producing an analagous effect on the organism. Cauterization is thus of two kinds, the *actual* and the *potential*, according to the agent employed in its production.

Potential cauterization, by reason of the nature of the agents employed, as well as of the method of employing them, belongs properly to the domain of therapeutics, and we shall therefore pass the subject by with a simple mention, to give our attention to what falls more particularly under the head of operative surgery, the *actual cautery*.

ACTUAL CAUTERIZATION OR FIRING.

Firing is one of the most valuable of therapeutic agencies. It is also one of the oldest and best known among methods of surgical treatment, in both human and veterinary medicine. It was practiced and recommended as far back as the times of Columelle, Absyrtus and Vegetius, when it was in high repute as a remedy for articular diseases, sprains and weakness of the loins; but towards the 15th century, its popularity waned somewhat, and it seemed to have partially lost favor, until the days of Markam and Gray in England, and Solleysel in France, where it regained by degrees its former repute. It now holds an established place among regular and methodical operations, and is one of the most important among our surgical resources, applicable in many pathological conditions, and efficacious in most. The following long list of ailments and lesions in which it may be indicated is given by Bouley.

(*a*) *Diseases of Joints.*—Exostoses around the borders of articular surfaces; sprains of ligaments; dilatations of synovial bursæ and indurations of their walls; dislocations; true or false anchylosis; deformities of the extremities from excess of work; congenital general weakness, etc.

(*b*) *Diseases of Bones.*—Exostoses; periostosis; callus of complete or incomplete fractures; caries; necrosis.

(*c*) *Diseases of Tendons.*—Partial lacerations; chronic swelling after tenotomy.

(*d*) *Diseases of Tendinous Sheaths.*—Dilatation; lacerations; changes in the structure of their walls.

(*e*) *Diseases of Muscles.*—Atrophy; induration; pathological changes of structure.

(*f*) *Diseases of the Cellular Tissues.*—Chronic œdematous swellings; induration; abscesses; cysts.

(*g*) *Diseases of the Nervous Apparatus.*—Paralysis; occult pains without visible lesions.

(*h*) *Diseases of the Lymphatic System*—Chronic lymphangitis; farcinous cords; pustules or tumors.

(*i*) *Diseases of Veins.*—Chronic phlebitis.

(*j*) *Diseases of Arteries.*—Hemorrhages.

(*k*) *Special Diseases.*—Carbuncular tumors; gangrene; ulcers; fistulas, etc.

To epitomise and simplify this long recapitulation, we may say with Gourdon, that the use of the actual cautery is indicated when its characteristic effect as an excitant and tonic is sought for in atrophy, or in diseases of joints; or again, as a modifying factor in chronic inflammation; as a derivative, and as a physical or a preventive agent.

It is contra-indicated in cases where there exists an excess of vital irritation, or of inflammatory tendency, until the symptoms which attend such a state of the system have more or less subsided.

Actual cauterization is divided into the *superficial* and the *deep*, the former being again subdivided into the *mediate* and the *immediate*. In the immediate the iron is applied directly to the skin, while in the mediate the action is supposed to be modified by the interposition of some kind of medium.

The various modes of actual cauterization, according to Bouley, are systematically exhibited in the following table:

- Superficial
  - Immediate
    - Transcurrent, in lines.
    - On surface, a la Gaulet.
    - In points or dots.
    - By ignited bodies.
    - By heated liquids.
    - By radiation or objective.
  - Mediate
    - By the interposition of kid skin or of a layer of lard.
- Penetrating
  - Rapid.
  - Inherent or disorganizing.
- Subcutaneous.

Peuch and Toussaint have added the needle cauterization, and firing with the thermo-cautery.

Overlooking several of these specifications, which are of little or no utility, such as the firing with the inter-position of ignited bodies, of heated liquids, kid skin, etc., we proceed to consider the various prevalent and established modes in daily practice and of general utility.

Transcurrent, or Firing in Lines.

The *Cautery*.—The instrument used in all these operations, while formerly made of different metals, is now made exclusively of iron, for which there are various reasons. It is not only because of its cheapness and excellence and the general qualities which give it universal precedence in the arts, but for some reasons peculiar to the case. Thus, its changes of color when heated, render it easy to gauge, proximately, the degree of heat, and it also possesses the property of retaining heat longer than many other substances.

The form of the cautery varies greatly. The style most commonly in use resembles a small hatchet, of triangular, prismatic shape, thick at its base and with a thin border or edge, sometimes convex, sometimes straight, and more or less sharp, according to the indication. The handle is, of course, of wood or other non-conducting material, and in respect to the weight, reference must be had to facility of handling and power of retaining heat. The

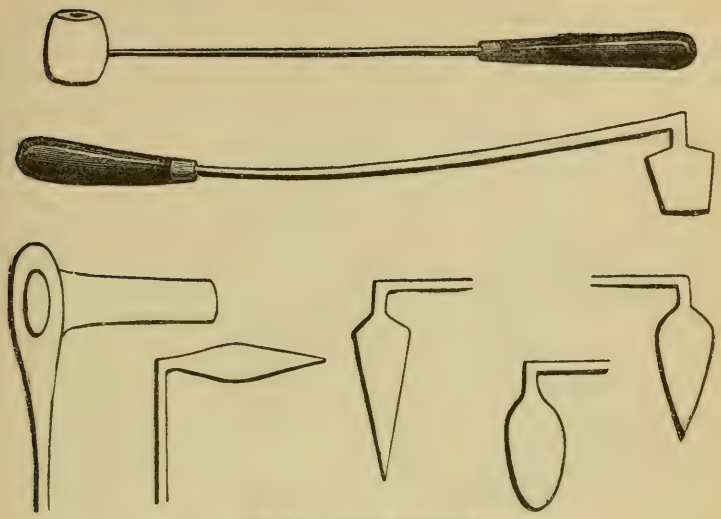


FIG. 201.—Various Cauteries.

lighter ones are usually preferred, not only on account of this facility, but as being less liable to produce too pronounced an effect.

Heavy instruments, in consequence of the degree of heat they radiate, and their contact with a broader surface of skin, are liable to transform the firing into the condition of a mere burn.

The size of the cautery will necessarily be regulated by the extent of the region to be treated. The cautery must be perfectly smooth, on its surface as well as on its thin edge, and to ascertain that this is the case, before they are heated a file should be passed over both surfaces, and before being applied to the skin they should be again inspected by the surgeon or an assistant, to be assured that the edge is clear and clean, and there is no roughness to cause a ragged and uneven line on the skin.

In heating the cautery, a charcoal fire is much to be preferred to that from the blacksmith's forge. The latter soon soils and blackens the instrument, while the former is smokeless and every way cleaner, besides being portable and always convenient.

There is no uniform rule to govern the position in which the animal must be secured. While there are occasions when he can be treated while standing, and kept under control by the simple means of restraint, in many, and indeed in a majority of cases,

it will be every way advantageous to have the patient thrown down and secured, in order that the region to be fired may be exposed as freely as possible—a point which has already been considered.

The parts upon which the firing is to be made must be thoroughly cleaned and especially free from scabs or greasy substances. The hair is to be clipped short whenever its length and thickness are likely to interfere with the action of the instrument; yet the skin must not be shaved, inasmuch as a thin coat of hair will always prove rather an assistance than otherwise, in drawing the first lines, by preventing the instrument from slipping.

There was a period when animals were fired with a view to their alleged ornamentation, without any pretext of necessity arising from disease, but simply in conformity to the behest of fashion (and possibly as a means of the identification of property), but this artistic firing for fashion's sake is now altogether discarded, and the burned-in shapes of fern leaves, stars, crosses, harps, etc.,

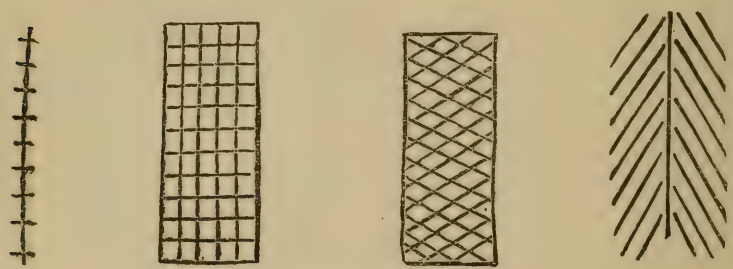


FIG. 202.—Old-fashioned Drawings.

etc., have made room for firings inflicted for better reasons and with more beneficient and valuable results.

And while the results of these æsthetic and artistic firings made for purposes of embellishment were usually ugly, unsightly cicatrices, thickened and hairless, the operations of the present time leave as their sequelæ but slight and superficial marks, which are hardly entitled to rank as blemishes, though in this connection must not be included the Prangé firing (Fig. 203), which, with its peculiarity, is applied as the ordinary line firing, except that the lines are divided in small sections.

Firing in lines must be applied not only upon the diseased part, but must extend somewhat beyond it, and the lines must be made as nearly as possible parallel with the direction of the hair.

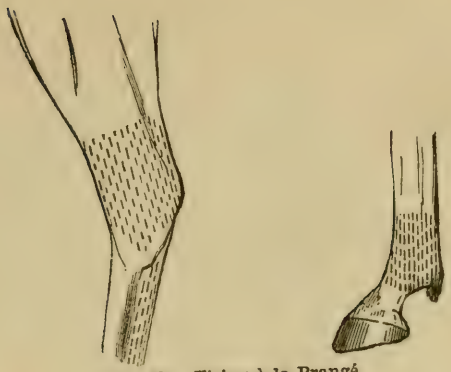


FIG. 203.—Firing à la Prangé.

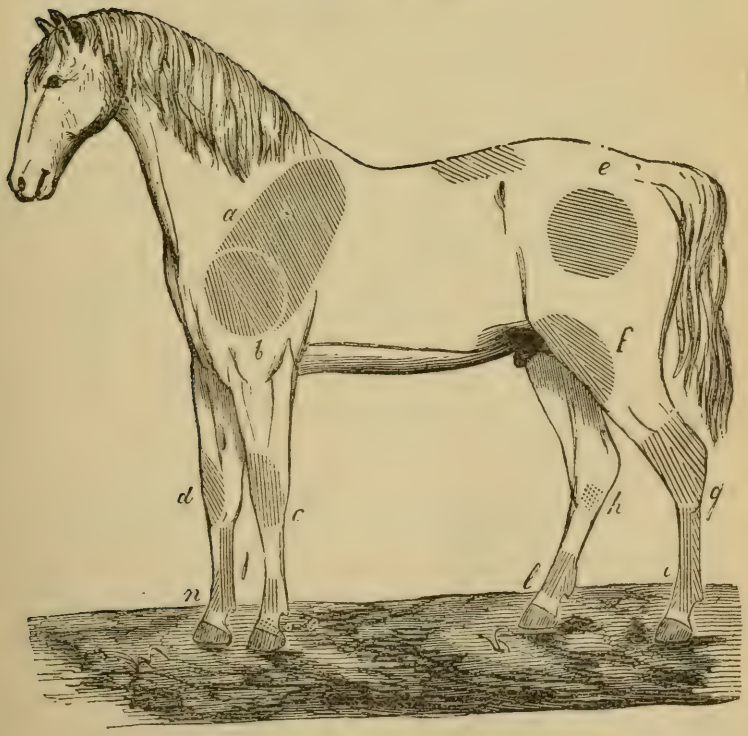


FIG. 204.—Various Forms of Drawing in Firing.*

* The firing on the loins we think ought to be parallel to the median line instead of oblique.

This rule we consider a very important one, although it is known that European veterinarians, when operating in some special regions, entirely disregard it, firing in lines running at right angles with the direction of the hair, though it is quite obvious that the result must be an irregularity in the growth of the hair and a wavy appearance, which can be entirely avoided by observing the rule we have referred to.

A glance at Fig. 204 will give the reader an idea of the proper form for making the drawings and the directions of the lines. Not only should the lines run parallel with the direction of the hair, but it is equally important that there should be no deviation in the width of the intervals between the lines. It would be impossible to give exactly the distance which must separate them, as this depends upon the thickness of the skin, the condition of the patient and the effects to be produced.

In drawing the lines it must be remembered that they ought to be of an even depth their entire length, but we do not think that this can be easily accomplished with the instrument having the convex edge, while there should be no considerable difficulty in effecting it by a steady and uniform manipulation with the straight edged iron, and by merely raising the hand at the beginning of the line and depressing it slightly at the end.

The cautery must never be passed in one line against the growth of the hair, and by always drawing it toward himself the operator will avoid injuring the bulbs, and escape the danger of causing a subsequent abnormal growth of hair. Nor should the cautery be passed twice in succession in the same line. If the instrument should slip out of its track before reaching half its length, the line should be abandoned and the next one proceeded with. To determine the lines correctly, and follow them accurately by the eye alone, requires a natural aptitude which all do not possess. It is an art, however, which, if possible, should be acquired, and as well as when existing naturally, cultivated and improved, by study and practice. But in the absence of the natural faculty, which it is so desirable for the surgeon to possess, resort must be had to the obviously reliable expedient of previous marking, by which a charcoal mark upon a light-haired, or a chalk mark upon a dark animal will obviate all risk of lack of symmetry and want of regularity.

The degree to which the cautery should be heated, as well as

the manner in which it must be moved on the skin, is to be determined by the steps of the operation. In beginning the markings of the firing or the *initial drawing*, the iron must be of a dark red color, just hot enough to burn the thin coat of hair left on the skin. By this method, any irregularity in the drawing can be removed and corrected by the passing of a second instrument. When the entire surface has been covered with the initial drawings, and everything is correct, the heat of the cautery can be slightly and progressively increased as the operation approaches the end. The rapidity with which the instrument is moved over a line should vary inversely to the degree to which it is heated, the thickness of the skin, the consistency of the subcutaneous tissues, and also the stage of the operation. Generally, the movement of the cautery should be accelerated when the heat is greatest, when the skin is thin, when the tissues underneath are hard, and when the operation is nearly completed.

Another important rule is not to apply too heavy a pressure upon the cautery when moving it over the skin. A slight pressure with a slow movemeat is harmless and even advantageous at the beginning of the operation, or when the skin is thick, but it becomes dangerous under the opposite conditions when the heat of the cautery is extreme. In such a case a true incision of the skin may be the result. Firing is essentially a bloodless operation even when severely applied, but it is only by the careful observance of the above rules that hemorrhage during actual cauterization can be avoided. Its appearance during the operation is, we believe, the result of inattention, and caused by too hastily raising the heat of the instrument, or more often by excessive pressure upon it.

The observance or neglect of these rules will demonstrate the difference between scientific and unscientific firing, and show that while one is *true scientific surgery*, the other is simply *burning the skin*. The first is applied by one who appreciates the value of the results he hopes to realize, while the other merely places a hot iron in contact with the skin, quite ignorant of the good or evil results which may follow the act. As the operation progresses, changes take place upon the lines, which give an indication of the strength of the firing. These objective changes consist in a change of color in the lines, and an accompanying exudation from the skin.

In the first degree, or *light* firing, the lines are not deep, and

are of a golden yellow tint, having only a few isolated drops of serosity at their sides, the dermis not being extensible, and the skin between the lines free from infiltration, the epidermis cannot yet be scraped with the finger nail. In the second degree or *ordinary* firing, the lines are of a lighter color, or bright yellow, the drops of serosity are more abundant, the dermis is more extensible, the skin between the lines is thickened with infiltration, and the epidermis is easily scraped off. In the third degree, or *strong firing*, the lines have a light yellow color, the dermis is so thinned that the slightest traction of the portions between the lines, which then become wider, stretches it, the serosity is abundant and overruns the edges of the lines, and the skin between them is infiltrated and possibly covered with small phlyctenases or blisters. To proceed further will be to produce a deep burn, which may be followed with serious complications, or at the least, leave large, unsightly cicatrices.

The length of time required to produce these effects, and the frequency of the applications upon a given region, are points by no means easily determined. They are affected by many contingencies, which cannot be anticipated. According to Fromage de Feugré, a cautery heated to a cherry color must be used in each line from ten to twelve times for a light firing, and from fifteen to twenty for more serious cases; but Gourdon considers these figures too high, and says that from five to six strokes will be sufficient for a firing of the first degree, from eight to nine for one of the second, and from twelve to fifteen for the third, or strong firing. But these figures have no absolute value. The number of strokes will depend upon many conditions, such as the heat of the instrument, the state of the parts and the dexterity of the operator.

The effects resulting from actual transcurrent cauterization may be divided into *primitive* and *secondary*.

(*a*) *Primitive effects.* — The inflammation which follows the burning manifests itself by the appearance of a serous exudation, the serosity being in the form of small drops, in greater or less abundance, according to the degree of the cauterization. This serosity collects between and at the bottom of the lines, and continues to flow for from twenty-four to forty hours, when it is replaced by the formation of crusts or scabs, dry, yellowish, and irregular, and if the firing has been light, attached to the bottom or the borders of the lines; but covering the entire cauterized sur-

face between the lines, as well as at the bottom, if the firing has been stronger. These crusts of dry serosity remain adherent for a few days only, and from the sixth day to the eighth they begin to separate, but the dropping off of the cauterized portions of the skin requires a longer time, varying according to the degree of the firing. In the first degree they are eliminated by the formation of a new layer of epidermis. It is a process of dry desquamation by which they are exfoliated, and requires from two to three weeks for its accomplishment. In the second degree, when the thickness of the cauterized tissue is greater, the scabs proper are more adherent, and it requires a process nearly allied to one of suppurative expulsion, which may consume a month before the final sloughing is accomplished. In the third degree, a regular process of suppuration is necessary for the removal of the scabs, and its completion will require a period of not less than five or six weeks.

After light firing, the marks left are scarcely detectable; after the second degree, the hair grows over the lines, but in an irregular way, giving a somewhat roughened appearance to the part, while the strong firing leaves a thick and callous epidermis, and therefore a serious cicatrix. Besides these first and direct effects of the cautery, there are others which ought not to be overlooked. About the parts where the firing has been applied, the skin and the subcutaneous tissues become the seat of extensive inflammation, accompanied with pain and swelling, and in some animals this may assume a severe aspect. The swelling may extend until it involves the entire extremity, and this may seriously interfere with the act of locomotion. It, however, subsides and disappears as the process of the removal of the scabs advances, and when this has been accomplished, the swelling and pain will also have disappeared.

(*b*) *Secondary effects.* These are slow in their development, and cannot be easily or well described, and they vary widely according to the objects for which the firing has been applied. It may be said, however, on general principles, that the development of secondary effects cannot be expected except after a considerable lapse of time, allowing at least several months, and in any case, only long after the objective effects have entirely disappeared.

The treatment following the operation, is of a very simple character. For a few days, and until the secretion upon the

cauterized parts has dried and the scabs have begun to slough, the animal must be restrained from lying down, and biting or rubbing himself, nor must this vigilance be relaxed, until the danger of breaking up the surface of the wound has ceased, with the temptation which was kept up by the continuation of the irritation, with the dropping off of the scabs and of the cicatrization. There is no necessity for interference with the sloughing of the scabs, or occasion for impatience to see them removed. After a period of time, which varies according to the severity of the operation, they will separate spontaneously, or with a little friction of the parts, or washing with tepid water and soap.

A question of some importance in connection with this operation, is that which refers to the use of oily or greasy substances in the treatment of the cauterized surface. In times past this was accounted to be good practice, and soothing embrocations were recommended and freely employed, but this treatment has become nearly, if not wholly, obsolete. At the most, vesicating preparations are considered allowable, but even these only under special conditions, as when the cauterization has not been sufficiently strong. This practice is specially prevalent in the United States, where the operations of firing and blistering are almost always associated. This combination has nothing objectionable, and in fact is justified by the apprehensions and opposition existing among Americans. Yet practitioners must always remember, that if many cases where firing is indicated terminate unsatisfactorily, after both firing and blistering, it is because the true and local effects of the cauterization, by ordinary or strong firing, have not been produced, when they were necessary to obtain good results. The possibility of ugly cicatrices cannot be well avoided if proper firing is to be depended upon. In view of the fact that the effects of firing are not limited to those which visibly and immediately appear on the surface of the skin, but that others of importance are also to be anticipated, after a certain time, the question of the duration of the rest necessary for the patient after the firing, becomes one of some importance.

All written authorities on the subject agree in saying, that this rest must be a long one, reckoning it by months, though in some instances light exercise, or even light work, may be allowed sooner. Generally speaking, however, the surgeon will be guided by the nature and history of his case, and especially by the extent

of the cauterization. The patient will of course require permanent and absolute rest for a few days, or until the serosity and the scabs have dried, but after that he may be allowed the liberty of a box-stall, or of the pasture, without interfering with the necessary oversight of his condition and progress. There are cases where moderate walking exercise could not be otherwise than beneficial in its effect upon the final result.

Though, as we have said, the application of greasy medicaments may not be recommended, yet, as a substitute or alternative, blistering ointments may be used to supplement too light a firing. It is, in fact, not rare to find it necessary to follow the firing with a severe blistering after the scabs of the first operation have fallen off. If this is done, however, it must not be until the more active effects have diminished, and the inflammation has subsided.

It may sometimes become necessary to solve the problem of the duty of the veterinarian in cases where an animal requires the treatment of the cautery on two places on one leg, or on two legs, or perhaps on the entire four.

Humane feeling alone ought to furnish a sufficient guide in this matter. When the operation is not only in itself so exceptionally painful during its performance, but is followed by further suffering arising from the necessity of protecting the animal against himself, it should be considered sufficient to inflict the firings singly, and after the first infliction to repeat the torture only after a respite of several days. On this point we differ from the opinion expressed by some European writers, and cannot discover the alleged benefit to be derived from any extra dispatch, in the absence of any urgent reason for considering it to be imperative. Our conviction is strong that one firing ought not to follow another until the immediate effects of the first have subsided, and the animal has had several days to recuperate from the great strain he has been compelled to endure.

The application of transcurrent cauterization is very often indicated in solipeds, and we borrow from Bouley a list of the ordinary lesions for which it is most frequently employed.

A.—Regions of the Extremities. *Coronet.*—Indicated against ringbones, circular periostitis following phalangeal arthritis, or deep penetrating wound of the foot; exostosis following fractures. Applied in lines, parallel to the axis of the bone; not too near to-

gether, to avoid sloughing of the skin; never fire beyond the second degree; avoid burning the coronary band. Results: generally efficacious, but necessary to repeat it.

Fetlock.—Articular or tendinous windgalls; exostosis; periostitis after sprains or arthritis; induration of tendons; cold infiltrations and induration of cellular tissue; knuckling. Applied in parallel lines, vertical in front and slightly oblique behind. Results: not so satisfactory, though in many cases favorable.

Cannon.—Splints; callous and thick tendons; cold infiltration and induration of cellular tissue. Applied as in the fetlock. Results: generally very satisfactory; second firing is often required.

Knee.—Articular and tendinous synovial dilatations at any part of the joint; hygroma; bony deposits. Applied in parallel lines, vertical in front or oblique on the lateral faces. Very advantageous for synovial dilatations and hygroma; less so in exostosis.

Forearm.—Bony growths of any kind; muscular weakness, manifested by sprung knee. Lines parallel to the axis of the region. Beneficial for exostosis; doubtful in the other cases.

Elbow-joint.—Bony deposits; dilatation of articular synovial sac. In parallel lines. Results very satisfactory.

Arm.—Weakness of olecranon muscles. In lines parallel to the hairs. Results very doubtful.

Shoulder.—Muscular atrophy; paralysis; diseases of the articulation, dilatation of the coraco-radialis bursæ; lameness of unknown nature, and located in that region, may involve the entire region, or it may only cover the scapulo-humeral angle. In the first case, applied in lines parallel to the direction of the hair, extending from the upper to the lower end of the scapula, the firing has an oval shape; in the second case, the firing is circular, and forms parts of two parallel lines, slightly oblique to each other. Generally advantageous in atrophy and occult lameness, doubtful in paralysis, not so much in articular or tendinous diseases.

Hock.—Articular or tendinous tumors, hygroma, dilatation of the bursæ of the extensors of the cannon and flexors of the foot, bony growths, peripheric periostitis, cold infiltrations, and indurations of cellular tissue. Drawings of the firing at the hock vary, according as it may be desired to fire the entire joint or only part.

In this latter case it is applied in vertical or oblique lines, forming a drawing as regular as possible. In the former case two ways are recommended; in one the surface of the hock is divided into halves by a line drawn parallel with the tendo-Achilles; all lines back of this one are parallel with it, and all those in front of it are parallel with the front of the hock, and therefore slightly oblique to the others. In the other method, a line is drawn from the point of origin of the tendo-Achilles vertically downward to the cannon bone, and upon this, oblique, feather-shaped lines are drawn on each side. Results, generally rather favorable in all the diseases of the hock.

Leg.—Bony deposits, rupture of the cord of the flexor metatarsi; chronic swelling applied in lines parallel to the region. Results, very advantageous.

Stifle.—Dilatation of femoro-patellar bursæ, exostosis of the patella, luxation, pain remaining after bruises or wounds, ligamentous fistulas of old standing. Applied in several parallel vertical lines in front, and on each side oblique to them. Results, almost always successful.

Thigh and Coxo-femoral Joint.—For similar lesions to those of the shoulder, atrophy, paralysis, occult lameness; same applications. Results about the same.

B.—Regions of the Body. *Loins.*—Weakness of vertebral column due to paralysis; sprain of the vertebral column, vertebral periostitis, occult pains. Applied in lines parallel or oblique to the median line of the body. Results generally doubtful.

Withers.—Chronic cysts, indurations following fistulous withers, old fistulas. A few lines parallel with the vertebral column, the others oblique. Results almost always beneficial.

Ribs.—Acute or chronic pleuresy and pneumonia. In lines parallel with the long axis of the ribs; seldom used, the results are difficult to appreciate. Principally used by Nicholson and Maclean against contagious pleuro-pneumonia.

Firing on the Surface, or a la Gaulet.

This is so named after its inventor. The mode of operation is with cauteries which have their border, or the part which is applied to the skin made to form a flat or slightly convex surface (instead of being thin and sharp), in order to remedy one of the principal objections to ordinary firing, that of leaving

permanent marks. It proposes to effect this by throwing upon the surface of the skin an even radiation of heat. The description given by Mr. Gaulet is this: "The iron being heated to nearly a cherry color, a straight line is made in the principal direction of the region to be fired, and immediately alongside of it another, and so successively until the entire surface is covered. The first lines are then crossed, transversely or obliquely, by others, which perhaps also touch each other, and at last, in order to have the entire surface evenly cauterized, the parts which have not been touched in tracing the original lines are also touched with the iron which then retains but one-half of the heat it possessed at first."

* * * "After twenty-four hours, or perhaps less, an inflammatory swelling takes place, and the skin is covered with small blisters of serosity; three weeks after, the crusts which have followed begin to drop off, and the hair is seen growing underneath them."

According to Bouley, this method cannot be substituted for the ordinary cauterization. If applied lightly, its effects are not more severe than those of an ordinary blister; but if applied in a severe form, it is liable to be followed by the sloughing of large portions of skin, and to leave behind cicatrices of the very worst description. It has, however, in the hands of Mr. Paul Bouley, given satisfactory results in its application upon the stifle, the point of the shoulder, and the cyst of the withers, and with Mr. Naudin, in the treatment of chronic swellings of the extremities.

Firing in Superficial Points.

This form of cauterization is performed with instruments of conical or olivar forms (see Fig. 201), having the point blunt and rounded, in order to rest on the skin without incising or penetrating it. The point must not be so long as to cool off too rapidly, nor so short as to be incapable of retaining a sufficient amount of heat. In this mode of firing, the points or dots are arranged in quintuples, a first series of points being marked in either a vertical, oblique or horizontal line, equidistant from each other, and more or less close according to the indications; a second series is marked on a parallel line, at a distance equal to that which separates the dots of the first series, and placing the first point on a line with the middle of the space separating the dots of the first

series, thus alternating the application of the points in a third and fourth series, until the whole surface is covered. This makes a regular drawing, and leaves but little blemish afterward.

The rules pertaining to the application of firing in straight lines are the same as in the cauterization in superficial points, and they apply to this also, but we believe this is to be better indicated in the firing of small surfaces, for bony deposits, ringbones, splints, spavins and side-bones, or generally in the treatment of circumscribed diseases.

FIG. 205.—Firing in Dots and Points.

Firing in points is always more effectual than that in straight lines, and being exempt from the danger of skin sloughs, it always leaves fewer blemishes. Moreover, in a majority of cases, it can be applied without casting the patient. These are points which should count largely in its favor. The principal objection to be urged against it is the greater length of time required to realize the full measure of its effects.

Mr. Prangé has invented a mode of cauterization, which is very similar to that in superficial points, but differing from it in the fact that instead of points, the ordinary flat iron is used. It is cauterization in lines, but instead of being long and made with one stroke of the cautery, they are divided into short lines (see Fig. 203), also arranged in quintuple, like the dots of the point firing. This method has not found favor with those who have experimented with it.

Objective Firing.

In this mode of cauterization, the heat is transmitted, not by contact, but by radiation. It is a process rarely resorted to, and when it is used it is more as an adjunct to transcurrent firing, or as a simple mode of revulsion. It consists simply in bringing the heated iron in close proximity with the surface to be cauterized.

Gaulet is reported to have obtained good results from it in the treatment of ulcers, grease and ophthalmia; Leblanc in chronic diseases of the eye, and Laux in the treatment of chronic lameness of the thigh. According to Gourdon, it is indicated for the arrest of some internal hemorrhage of mucous membranes; for the reduction of prolapsus of the rectum and of the uterus; in hernias; to stimulate the cicatrization of ulcers, and against some chronic inflammation of mucous membranes, of the conjunctiva, the pituitary membrane, etc.

The cautery used by Mercier is square, oval or circular, with the surface, which is to face the skin, unpolished, while the other is smooth and polished, a disposition designed to graduate the firing by facilitating the radiation of the heat with the first, and diminishing it with the second.

The special aim in this plan is to avoid the formation of a slough, and to attain it as perfectly as possible, the firing ought to be so managed, as to approximate the point of disorganization as nearly as possible without reaching it.

In operating, the surgeon, after satisfying himself of the condition of the skin and its subjacent connections, moves the instrument to and fro over the part, carefully avoiding contact with the tegument. If the hair burns too quickly, it indicates an excess of heat, or that the instrument is too near the surface. The heat should be gradually increased from a brown to a cherry red color. The duration of the operation depends on the condition of the skin. When the epidermis can be easily scraped with the finger-nail, or is raised by the formation of small blisters, and the fired surface becomes moist, and shows little drops of serosity, and the skin becomes thicker, denser, and more adherent to the subjacent tissues, the evidence is present that the proper degree of firing has been reached.

The serosity increases immediately after the operation, and for some time continues to flow, until the surface is covered with

its dried pellicles or crusts. On the second or third day an inflammatory swelling is developed, and all the symptoms of ordinary firing are manifested, and after three or four weeks the resolution is complete.

If the firing has been too severe, the serous secretion becomes very abundant, and the inflammatory swelling increases rapidly and becomes warm and painful. Towards the fifth or sixth day the skin becomes black, dries up, shrinks, is raised in large patches, and sloughs off, leaving a broad surface, covered with large granulations, very slow to cicatrize. One great advantage which objective cauterization can claim over ordinary firing is, that when properly performed, it leaves no blemish whatsoever.

Deep Cauterization.

The cauterization which is carried beyond the thickness of the skin and penetrates the subcutaneous structures, receives this designation.

The manner in which the cautery is inserted into the tissues, and the length of time it is allowed to remain in contact with them, have justified the division of this kind of cauterization into *rapid deep*, and *inherent*, or *disorganizing* cauterization.

Rapid Deep Cauterization.

This is the comparatively recent mode known as *needle firing*, inasmuch as it consists in the insertion of elongated sharp, needle shaped cauteries, heated to a light red. Urbain Leblanc is credited with the introduction of this species of instrument and is the

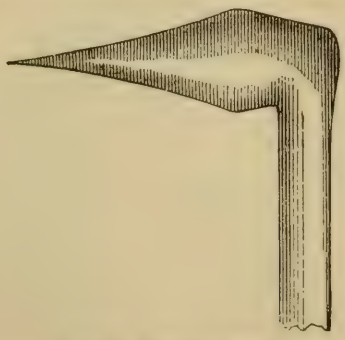


Fig. 206.—Abadie Cautery.

author of the first report of its results. The first cautery used by Abadie resembled the one shown in Fig. 206. In using it, the animal is generally secured in the standing position. It is applied at a light red heat and made to penetrate through all the tissues down to the subcutaneous cellular structure, and even through the synovial sheaths. Leblanc's advice is to make the puncture by passing the iron three or four times in succession in the same spot, but Abadie completes it at a single stroke. This firing is followed by severe inflammation of the parts, great pain, swelling, abundant serous secretion, and the escape of synovial fluid. It has, therefore, powerful revulsive effects, which, however, leave scarcely any marks, provided only the finest parts of the cautery have penetrated the tissues. Otherwise extensive and fatal suppurative arthritis may be looked for. This cauterization is indicated in cases of exostosis, tendinous swellings, articular and tendinous synovial dilatations, splints, ringbones, spavin, sidebones, thick tendons, articular and tendinous windgalls, thorough pins, blood spavins, etc.

In the true needle cauterization or ignipuncture, the form of the cautery is changed, but in all other respects there is no difference.

The forms of the needle instruments are numerous, and of course each one claims some special merit. The cautery of Bianchi and that of Foucher were first used, and these were followed by the instruments in which the point or needle of platinum could be changed. There were others of more complicated make, as those of Bourguet, Salles, Lagarrigue, Vasselin and others, or

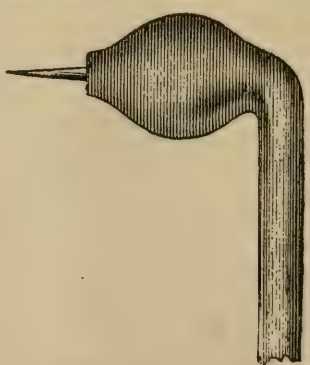


FIG. 207.—Bianchi Cautery.

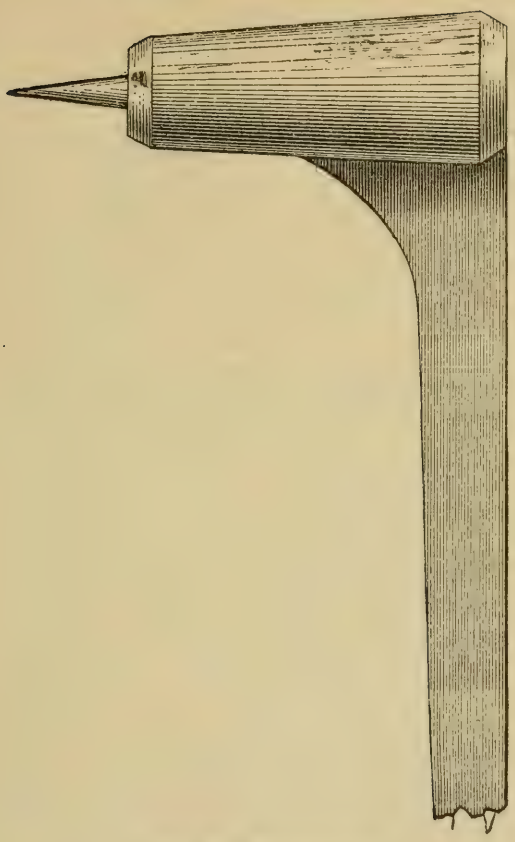


FIG. 208.—Foucher Cautery.

of more recent invention the autothermic cautery of Mr. Ehret (Fig. 211).

In using these instruments, whatever may be the position of the animal, the perforation is made with a single stroke only, the points being from three-fourths of an inch to an inch apart. When operating on a synovial bursa, the needle is applied but once; but if the skin is thick and indurated, two or even three times may be necessary. The subsequent application of a stiff blister is recommended by some, immediately after the operation, but by others after an interval of a few days. This firing is always accompanied by severe inflammation and its usual phenomena, but it generally subsides after a few days.

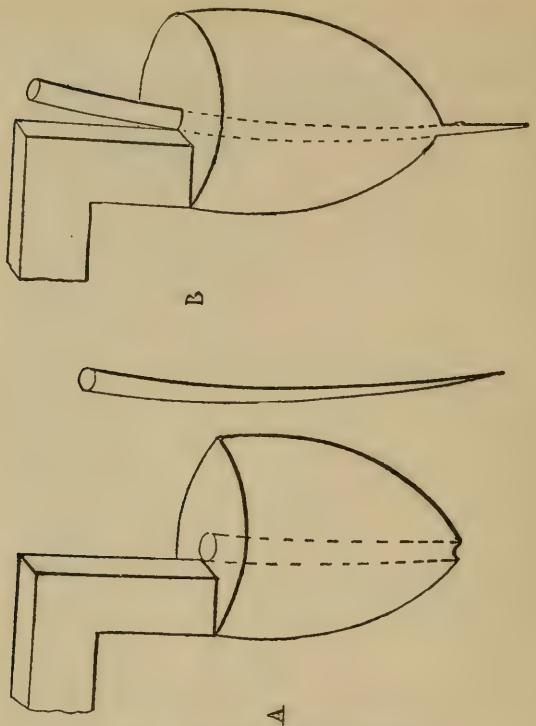


FIG. 209.—Cautery with Changing Points.

No severe accidents are likely to accompany needle firing. Small hemorrhages may occur, but they usually cease spontaneously, though it must be admitted that fatal cases of arthritis have been recorded, which, however, are avoidable by the use of proper precautions. The attention required by the patient after these operations do not vary from those required in ordinary cauterization, although the duration of the period of rest, always necessary, may be less prolonged.

INHERENT FIRING.

This differs from other kinds, in being performed with the cautery heated to a white heat, with a view to produce more or less deep disorganization, according to the needs of the case. Sometimes the application is made upon the surface only, but at others at a required depth upon the deeper tissues.

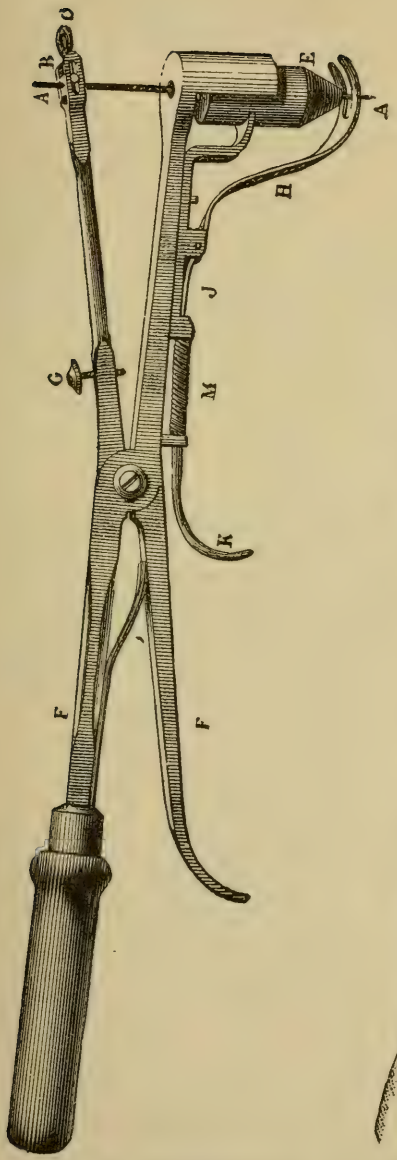


FIG. 210.—Bourguet Cautery.

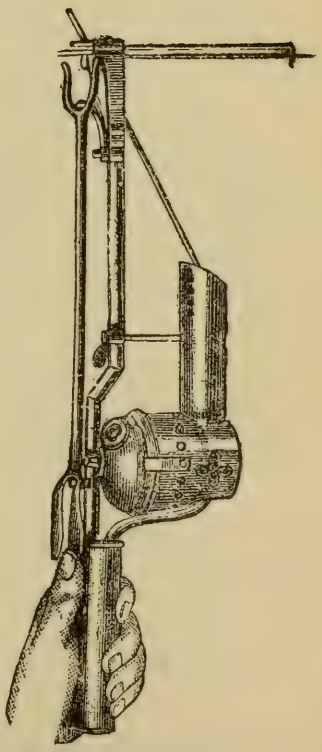


FIG. 211.—Autothermic Cautery.

In the first instance, it is indicated in superficial cutaneous ulcers, in wounds indisposed to cicatrize; in those following warts, in fungoid growths, in cancerous, melanotic or fibrous tumors, in gangrenous wounds and those following the opening of a cold abscess; in fistula due to caries or necrosis of bones, tendons or ligaments, etc. The instruments used are of various shapes: round, olivary, annular or cultellar. They are applied firmly upon the tissues, and held in place for a few seconds, according to the density of the parts If the surface is wider than the instruments, the firing must be done by sections, applying the iron in detail upon spots, until the entire surface has been touched. This is a better method than that of rubbing the instrument over the surface, and renders the effect more regular and uniform. In the second degree, or the cauterization into the depth of the tissues, a conical instrument is used and held in its place of insertion until it has lost most of its heat, thus reaching whatever depth may be necessary.

This cauterization is indicated against anthracoid, gangrenous, farcinous and cancerous tumors; in wounds of a virulent or venomous nature; in purulent infiltrations of the skin or of the cellular tissue; in caries of bones, tendons, cartilages and ligaments, in dental caries, in indurated tumors, in fungoid growths, polypoid granulations, etc. Renault has recommended them in the treatment of the large sores so often occurring in granular dermatitis.

Subcutaneous Cauterization,

Otherwise known as Neapolitan cauterization, or "a la Nanzio," consists in the application of the cautery in points directly upon the muscular structure, exposed by an incision made through the skin. The method was known and had been mentioned by Ruini, Solleysel, Bourgelat, Reynal and others in more or less modified and varying terms, before Mr. de Nanzio called the attention of the profession to the good results he had obtained by it.

Its application is principally efficacious in the treatment of chronic lameness of the shoulder or of the coxo-femoral joint. The instruments required are two bistouries, one curved and one straight, two flat tenaculums, a bull-dog forceps, scissors and an ordinary olivary cautery. De Nanzio thus describes the opera-

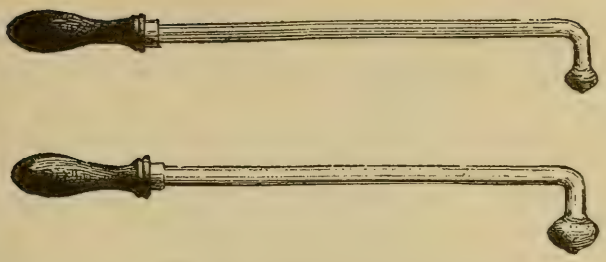


FIG. 212.—Cauteries of Nancio.

tion: "My method consists in making an incision from above downward to the skin covering the articulation, the location of which has been first carefully determined. The skin is then dissected from the cellular tissue, and the flaps enveloped with folds of wet cloth. The flat tenaculum placed on each border of the incision keeps it open, and with a blunt cautery, not too red, three

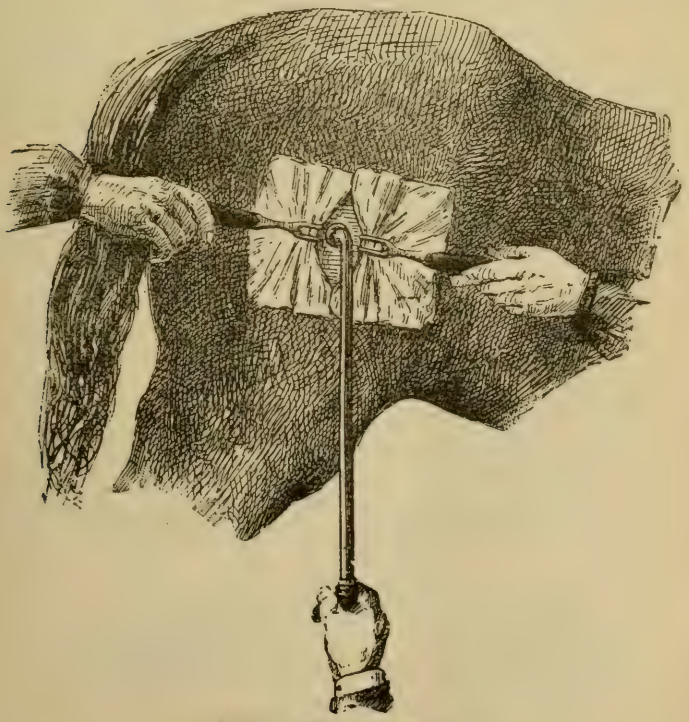


FIG. 213.—Firing à la Nancio.

or four points are applied upon the seat of the articulation, carefully ascertaining with the finger the point which the cauterization has reached, and carefully avoiding the opening of the joint."

The subsequent treatment is simple, and consists in cleanliness, lotions of clear or slightly astringent water, and the protection of the wound by small threads of oakum. The suppuration is abundant and the wound ugly, but these effects are soon modified, and healing is followed by only a simple linear cicatrix. Severe complications have been recorded as sequelæ of this operation, but, on the other hand, several authors have spoken of it in very favorable terms. Our own experience with it has not been sufficient to warrant the expression of a confident opinion.

Cauterization with the Thermo-Cautery.

This valuable instrument, the invention of Doctor Paquelin, has only within a comparatively recent period been added definitely to the armament of the veterinarian. The original instrument, as used in human surgery, has been modified by the inventor, and as now sold by our instrument makers, is fully adapted

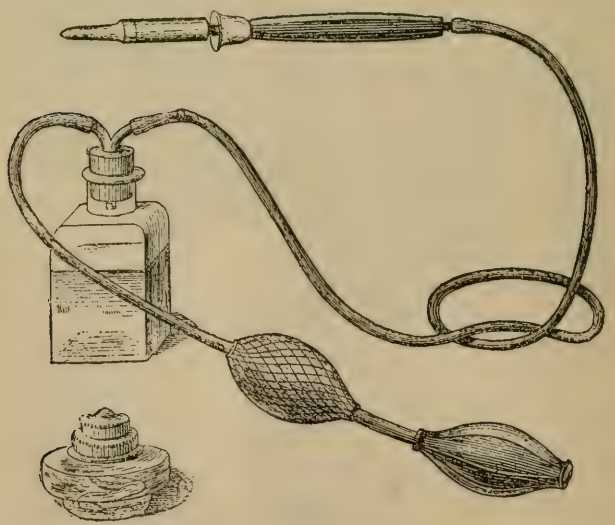


Fig. 214.—Paquelin Cautery.

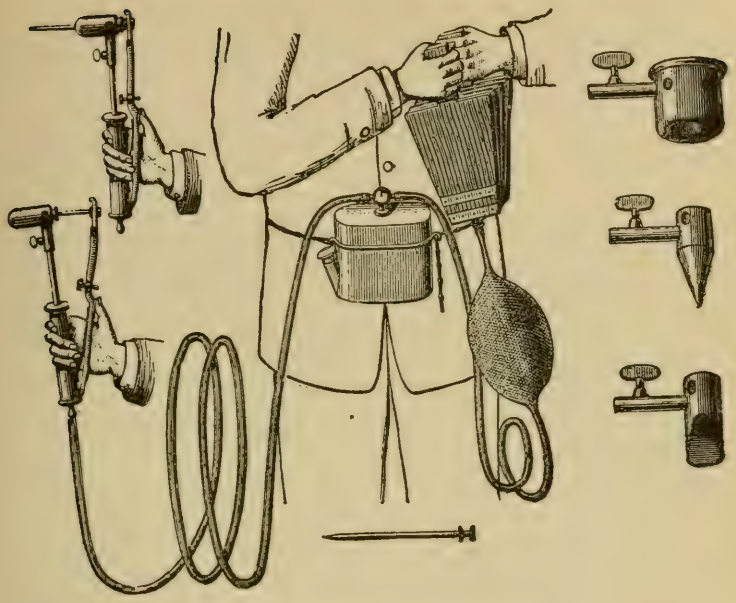


FIG. 215.—Paquelin and de Place Cautery.

to veterinary practice, and possesses points of superiority over all the rest. It is used in the same manner and under the same rules as other modes of firing already considered, but while its application is followed by similar results, it possesses also many other attendant advantages, which render it a valuable addition to our operative means.

The veterinary cautery of Paquelin and de Place is a modification which has recently been introduced, and which is considered superior to the original instrument by those who have used it, principally on account of the facility with which an even degree of temperature is kept during the entire length of the operation. The low price of the instrument is also an important item for veterinary practice.

CAUTERIZATION IN OTHER ANIMALS.

Firing in Large Ruminants.—If firing is not as commonly used with these animals as with solipeds, it is not because its necessities are less frequent, but rather from economic considera-

tions, and because when they become seriously disabled, instead of subjecting them to expensive surgical treatment, a wise pecuniary policy consigns them to the shambles where they may still claim an unimpaired market value; while a dead horse is (in popular estimation, at least) held to be of no particular worth in theory, that is, whatever may be the unconscious practice of uninquiring eaters of "beef."

It has been applied, however, in very numerous instances, by Cruzel, Roche, Lubin, Festal, and especially by Lafosse, who recommended its application in articular, muscular and tendinous lameness; for synovial dilatations, bony growths, anchylosis and luxations, and also in nervous affections, epilepsy, paraplegia, various paralytic cases and amaurosis.

The *modus operandi* is the same as that already described for solipeds, although allowance must be made for the thickness of the skin, which requires a deeper application, and necessitates the repetition of the firing from twelve to fifteen times in the same line, in order to obtain an ordinary effect. The scabs of the firing generally separate in from fifteen to twenty days, and leave pale rose wounds, followed by cicatrizations with a smooth surface. The swelling of the parts, and the reactive fever following the operation, is more severe, but subsides quite readily. The animal must be prevented from rubbing or licking himself in order to obviate the danger of secondary wounds with their troublesome complications, as with solipeds.

In *smaller animals* cauterization is seldom resorted to. In dogs, however, its application is sometimes indicated in lameness of the elbow, the stifle, and even the hip joints. Superficial firing by points has been advantageously applied, and is recommended by Peuch and Toussaint.

Accidents of Actual Cauterization.

To a great extent, the accidents and failures following the use of the cautery result from the non-observance of the rules established for the regulation of the operation, and subsequent careless and incompetent nursing. The remedy for these is too obvious to need mention.

(*a*) *Section of the Skin.*—This is a very common accident, usually chargeable to the carelessness or incompetence of the sur-

geon, or it may be caused by the use of too heavy or too sharp an instrument, or to an excess of heat or of pressure. It is recognized by the separation of the edges of the wound, and the appearance at the bottom of the lines of a white nacreous stria, shown by the subcutaneous tissue. There is no remedy for this accident, and though it is not a very severe lesion, it is likely to be followed by rough and irregular cicatrices.

(*b*) *Hemorrhage.*—We have said that firing is an essentially bloodless operation if properly performed. The appearance, therefore, of drops, or perhaps of a small stream of blood, at the bottom of the lines or points, and perhaps running over the surface of the skin, though unattended with danger and not likely to be injurious, is, at the least, evidence of some miscarriage of skill. If it arises from the use of a rough or too sharp an instrument, it can be readily suppressed by *searing* the part, or applying upon bleeding vessels another cautery, heated a little in excess of the first. Sometimes the burning of a small quantity of pulverized resin, or of a small lock of hair in the bleeding cavity, will have a sufficient hemostatic effect, and simple pressure will seldom, if ever, fail.

(*c*) *Tearing off Scabs.*—This is the result of careless and insecure dressing, and in omitting to provide effective safeguards for preventing the patient from reaching the wound with his own teeth, or rubbing it against some hard object. Suppurating wounds of various dimensions are often the result of this inadvertency, requiring careful treatment, and sometimes leaving bad blemishes to be regretted.

(*d*) *Sloughing of the Skin and Subcutaneous Tissues.*—This accident is not uncommon, and like that just mentioned, is the effect of the improper application of the cautery, though less the effect of the firing than of burning the parts, and it is characterized by all the conditions of ordinary burn wounds. Among specific causes, however, may be mentioned too strong a firing, or firing with lines too near together, or touching each other at some angle, or in crossing, or when too large an iron is used, or one brought to a radiating heat, or too high a temperature; or when greasy substances have been applied in the lines, or the skin submitted to long frictions. All these causes tend to the disorganization of the skin, with mortification and sloughing, and its separation in large patches, leaving after healing, broad, ugly blemishes.

(*e*) *Bad cicatrices.*—Though firing, however carefully applied, will always be followed by legible marks, there are cases in which bad, callous cicatrices form a positive and repulsive life-long disfigurement of the animal. In the most aggravated forms of the accidents enumerated, there are circumstances which particularly favor their occurrence. Among these may be regarded the thinness and sensitiveness of the skin, the interference of the animal himself, by rubbing and biting, and an excessive suppurative action accompanying the falling off of the scabs. No treatment is known that can be made effective against these lesions, but it is satisfactory to know that they do not inhere in the operation, and are preventable in the exercise of proper skill by the operator, and attention by the nurse.

EXUTORIES.

An executory is any therapeutic agency or means the effect of which is to promote the formation of purulent matter, and to sustain the suppurative process after it has been established. Some exutories have no special intrinsic qualities, and simply take effect in the manner characteristic of foreign bodies when lodged in any portion of the system; while, on the other hand, some of them possess specific properties by which a special irritation is produced in the tissues with which they come in contact. The various forms of seton are included in the first class; the trochiscus, blisters, however composed, the moxa, and the actual cautery belong to the second. But while the fact of the utilization of the operation is as old as the practice of medicine itself, the modes of application and the materials used have varied considerably during various epochs. The use of the root of black hellebore was recommended for diseases of the ears in large ruminants, and also in the treatment of diseases of the chest, or in œdematous swellings of the abdomen.

At a later period, the actual cautery found its advocates in the treatment of tetanus. The introduction of feathers, or long quills under the skin, in the treatment of old shoulder lameness, followed, and in some parts of the world this practice has not yet been wholly abandoned. Sometimes the feathers were used alone, and in other cases air was blown into the cellular tissue under the skin, in the parts where they were to be placed. The

first description of the seton and its effects was given by Markam, in 1556. But even after that date we read of the use of irritating soft pencils, or candles composed of various ointments, melted or mixed together, and introduced under the skin, incised for the purpose, and more or less massed or bruised with some hard substance. But the accidents which were apt to accompany some of these energetic forms of treatment were of so serious a nature that they gradually fell into disuse, and to-day this class of principal exutories includes only the seton in its various forms, the trochiscus and the vesicating preparations.

Exutories act as counter irritants, resolvents, and alteratives. The irritation which follows their contact with the living tissues excites the purulent secretions, and the activity in the process of interstitial resorption, which they stimulate, render their adoption and frequent use a source of much benefit and great satisfaction to the veterinary practitioner. The list of ailments in which their value is manifest and unquestioned is a long one, and comprehends affections of the chest, catarrhal inflammation of the air passages, and affections of the abdominal organs, with those of the eye, and in dogs of the ear. They stimulate the resolution of local affections having a tendency to chronicity, for example, œdematous swellings of the extremities, and they are frequently indicated in diseases of the locomotory apparatus, in certain affections of joints, and in rheumatic lameness, and also to excite the resolution of soft tumors, especially those of the synovial structures. The most eligible of the forms in which exutories are prepared, especially when they are designed to act as a means of drainage, or to prevent the accumulation of pus in anfractuous cavities, is the seton. It is recommended in nervous affections and in paralysis, and also for the relief of atrophied regions, and, according to Bouley, it may often become a means of diagnosis, as well as of prognosis.

In an acute disease having a tendency towards recovery, a seton will have an irritating effect, and give rise to a phlegmous swelling about its tract, while in the same disease, if the tendency be toward a fatal termination, the artificial suppuration which it causes will soon cease to flow, and the tract will remain comparatively dry.

There have been those who have made the seton a prophylactic agent, or insurance institution, to be made use of at certain

special periods or seasons of the year, and have thus invented the *seton of prevention* or of *precaution*, but without satisfactorily demonstrating what is to be prevented, or what anticipated. The theory, if any, in which such an assumption originates cannot be certified, and honest veterinarians cannot themselves identify it with such a practice or pretext.

If exutories are a frequent resort, and are highly appreciated in veterinary surgery, and their general use is commonly unattended with danger, yet they are not always so absolutely harmless that they may be trifled with, and prescribed without due consideration of the peculiar conditions under which their use is contra-indicated. It cannot be rationally supposed that the potency to which they owe their beneficial effect when rightly directed is to vanish when it is erroneously applied, and that it can be made innocuous by misdirecting it. Animals debilitated by heavy work or by disease; those affected with chronic organic ailments; those threatened with eruptive diseases, or suffering with septic complaints; none of these are fit subjects for the application of exutories.

SETONS.

A seton is a form of exutory which consists in the introduction of a foreign substance under the skin, ordinarily a band of linen tape, or a leather ring. The former is known as the tape seton, while the second is more appropriately termed a rowel.

Tape Seton.

This is usually merely a piece of clean, white tape, of suitable width and length as required by the case. In some circumstances, however, cords or braids of lint or horse-hair are substituted. The seton may either be introduced under the skin alone and dry, or it may be saturated with some irritating fluid, or covered with a stimulating ointment, to increase its effect and promote the purulent secretion. The operator must not fail to allow a sufficient length to securely tie the ends which pass out at the two openings of the tract through which it is drawn. Yet they are not always secured by an ordinary knot, but are quite generally united by a species of twist upon their extremities, which can be readily loosened when it becomes necessary. This knot must be sufficiently wide and strong to prevent it from slipping through

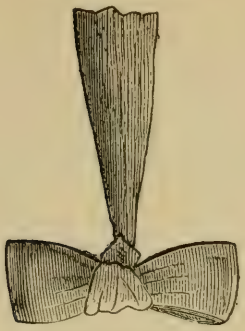


FIG. 216.—Seton Knots.

the incision. In some cases, instead of making a knot on the tape, small wooden pins are secured at the extremities, and answer the same purpose.

The essential instrument required to apply a seton is the peculiar needle known as the *seton needle*. It is, of course, made various lengths, some consisting of but a single piece (Fig. 218);

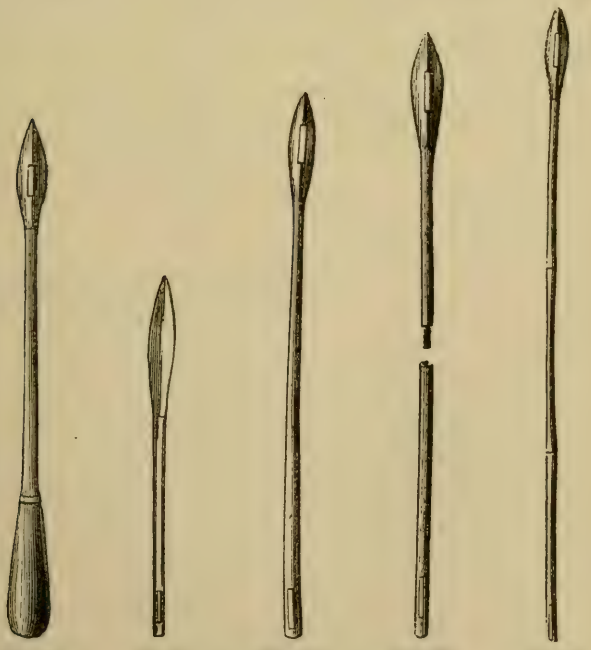


Fig. 217. Fig. 218. Fig. 219. Fig. 220. Fig. 221.

SETON NEEDLES.

while others are in two or three sections, connected by screw joints (Figs. 219, 220, 221), and in some few instances fitted to handles (Fig. 217). But however they may otherwise vary, they are in the general form of a stiff, iron rod, with one lanceolated extremity, both edges sharp, and a large eye at the blunt end to receive the tape. The lanceolated portion is slightly curved on the flat side. There are also other forms designed for special objects, among which may be mentioned one which is used for passing a seton through the frog of the foot, and is therefore known as the frog seton-needle.

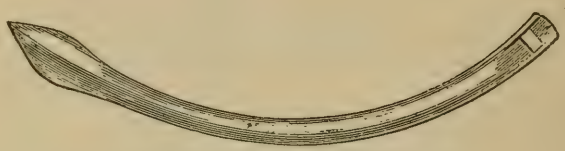


FIG. 222.—Frog Seton Needle.

For small animals, such as the dog, the smaller sized straight needles are often suitable, and the one which is used for making the quill-suture is very convenient.

Besides the seton needle proper, in its authorized and usual patterns, occasions sometimes occur when to meet special requirements, a straight, pointed bistoury and a pair of scissors are required as adjuncts.

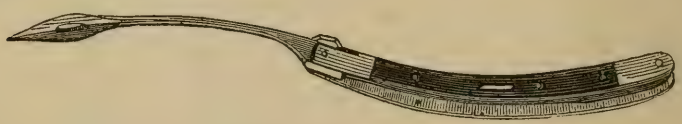


FIG. 223.—Quill Suture Needle.

The operation of setoning is comparatively a bloodless one, and the division of the cellular tissues through which the needle passes is very often made without any hemorrhage. Yet there are regions where more or less blood may subsequently escape. A region, therefore, where the cellular tissue is abundant and loose, is that which is most favorable for the introduction of setons.

The *modus operandi* is simple. The hair must be closely clipped from about the points selected for the two preliminary punctures, one for the entrance and one for the exit of the needle,

and the patient must be properly secured. Certain nervous animals may oblige the surgeon to place them in the recumbent position, but our experience has taught us that the cases in which this is necessary are very exceptional, and that in the great majority of operations, the simplest means of restraint, a twitch, with the raising and securing of one or two of the extremities, is all that is required.

The application of local anesthesia, so far as it may be practicable, is also a measure which is in all respects judicious and commendable. With the spraying apparatus, any part of the body can be reached with great facility.

In introducing the needle, many veterinarians pass it directly through the skin, which is raised in a fold, and drawn away as far as possible from the deeper tissues. This may be readily practicable in regions where the cellular tissue is very loose and abundant, as under the chest; but it is much less so, and more dangerous where the skin is thick, and the subjacent connective tissue is deficient or scant, and especially if the edges and point of the needle are not perfectly sharp.

For this reason the method preferred by many is more judicious, of making an incision with the straight bistoury through the skin at each of the two extremities of the proposed tract through which it is intended to pass the seton. The manipulation is sufficiently easy and simple, the operator holding the skin in a fold with one hand, while with the other he guides the needle under the skin and parallel with it, through the cellular tissue, entering through one of the punctures made with the bistoury, and emerging through the other. The point most important to observe here is that of so guiding the needle in its motion that it shall neither plunge into the deeper tissues nor emerge outwardly at the wrong place. At this point the scissors may be utilized by laying blades flatwise over the place of exit, and pressing down the surface. Directions are sometimes given, as the next step, to insert the tape into the eye of the needle, but it would seem that the safer plan would be to have the tape already in place when the needle is introduced. After the tape has been drawn through, and the needle disengaged, the next and final step is either to unite the ends of the seton by a knot, or, without tying, to secure them separately by the twisting or plaiting already described, and leave them free.

The first effects following the application of a seton are those met with in a majority of ordinary wounds; more or less swelling and inflammation, followed by an access of the suppurative process. At the points of insertion and exit of the needle, a certain amount of hemorrhage takes place, generally of no importance, and subsiding without interference, and this is succeeded by a swelling along the braid of the seton, at first more or less diffusible, with a tendency to increase during the first forty-eight hours but then becoming more defined. In the beginning, and for the first two days, there is a flow of a thin serosity from the opening of the seton, which gradually assumes the character of suppuration of good quality in the shape of creamy, laudable pus. Up to this period the seton needs no attention, and should be left without interference, to exhibit the natural traumatic effect of its presence. Although it is desirable to have the suppuration well established and flowing freely, it must not be permitted to accumulate in the tract, and should be subjected once or twice a day to gentle pressure along the entire length of the seton, to expel the least portion of purulent matter present. At the same time, such a pressure as would be likely to crush the granulations of the wound and thus excite small hemorrhages, must be avoided.

The cleaning and washing of the openings of the seton, and of the tape itself, must be carefully and strictly performed as often as the abundance of the discharge requires it. It should be systematically attended to, not less than once or twice daily, at the least. Precautions must be taken to prevent the animal from biting and pulling off the seton, and yet this accident is very possible, and it may frequently become necessary to replace it. In that case the needle should be introduced by its blunt end, with the new tape previously inserted in the eye. At times it becomes necessary for other reasons to renew the seton. A feasible way to effect this will be to attach the old tape to the new, and draw out the former by means of the latter. The length of time a seton ought to be allowed to remain in place varies according to circumstances, extending to a period of from three to four weeks, or even longer.

When the time has arrived for the discontinuance of a seton, if more than one have accomplished their purpose and had the desired effect, they ought not to be all removed at the same time, but singly, and with an interval between them. Nor must the

wound be neglected because the seton has been removed, but it must receive needed attention for several days. The openings of the tract will still require cleaning, and the residue of the pus will still require the aid of pressure to effect the final emptying of the wound.

Tape setons are applied upon all parts of the body, but more frequently, of course, in regions where their therapeutic effects are most needed, for which reason they will be most commonly found on the breast, the ribs, the shoulder, the hip, the thigh, the stifle, the abdomen, the neck, the cheeks and the foot.

(*a*) *The Breast.*—This is a very common location for the setons. In inserting it the animal is secured in the usual way, but to prevent his striking the operator with his fore feet it will be necessary to have one of his hind legs raised and firmly held. If there is but one seton it must be introduced on the median line; if two, one on each side of it.

The position assumed by the operator varies, according to the ability he possesses, and the hand with which he operates. If ambidexter, and but a single seton is to be introduced, he can operate from either side of the animal, and if two are to be inserted, he can change the needle from one hand to the other, to suit his convenience, without change of position.

This seton is to extend from the anterior extremity of the sternum downward and backward, under the chest, or between the fore legs, backward beyond the elbow. When the incision of exit has been made, and the tape introduced into the eye of the needle, the instrument *must* be drawn away in the direction opposite to that in which it was introduced, to avoid the possibility of doing injury with the point or the edges.

(*b*) *On the Ribs or the Chest.*—Setons are used in these regions for the treatment of diseases of the thoracic organs. Sometimes as many as three are applied, either on one or both sides of the chest. They should be placed in a slightly oblique direction from before backward and from above downward, beginning about the middle of the side of the thorax, and extending as far as the lower border of the chest, occupying, therefore, the lower half of the thoracic cavity. The manner of inserting the seton in the tract made by an incision with a bistoury through a fold of the skin has been already described, and a repetition in minute detail becomes unnecessary.

Care must be taken while operating in this region to avoid wounding the spur vein, which can be done by raising the skin well from it when the point of the instrument has reached its course, by which movement the needle passes outside of the vein and can be brought outside on the inferior border of the thorax. The tape is then placed in the eye of either the needle or the blade as already frequently described. Our own practice is to secure the tape through the eye of the *blade*, and draw the tape into position by removing the needle from below upward, considering this plan to be both more convenient and less dangerous.

(*c*) *At the Shoulder.*—Setons are often applied in this region against lameness of old standing; at times only one, at others two, or even more, according to the extent and location of the diseased region. When applying more than one, they are commonly placed parallel with each other. Many practitioners place them crossing each other, meeting in the middle of their length, with their point of meeting on a level with the center of the scapulo-humeral joint. In placing them, the compound, or three-jointed needle, somewhat flexible (already described), will be necessary, as being capable of adapting itself as much as possible to the convexity of the joint. Some care is required in the selection of a proper place for the puncture, and the animal must be kept in the standing position as much under restraint as possible.

There is probably no special rule for the location and direction in which setons should be applied, the discretion of the operator, in many cases, furnishing the only guide. This is well illustrated in the application of the *monstrous* "seton *a la Gaulet*," so called from its inventor, and which consisted in surrounding the entire scapular surface with one immense seton, beginning at the cervical angle of the scapula, running along its anterior border to a point below the shoulder, passing in front of the breast to the axilla, through that region, horizontally back on a level with the elbow, to return outward and then upward to the dorsal angle of the scapula, where it ended. This form of exutory is no longer tolerated, the dangers attending it, from the severe and exhausting drainage of the organism having brought it into discredit, with the result of its dismissal from general practice.

A seton at the shoulder requires special protection from the animal, by means of the cradle or the side bars, its location

making it too easily accessible to his teeth to be suffered to remain long in place without such a defence.

(*d*) *Seton at the Hip-Joint.*—Lameness of this region is frequently treated by the tape seton, the conditions of their application being nearly identical with those required when the shoulder is the region involved. They are placed, whether single or double, directly over the articulation, or crossing each other in the X form, and also over the center of the joint; and care must be taken that they are not inserted so obliquely as to interfere with the free flow of the pus. A needle similar to that used with the shoulder will be found convenient, and for a similar reason, the thickness of the skin, and the closeness of its connection with the sub-tissues, will render necessary the preliminary incisions with the bistoury to facilitate the entrance of the needle; and the control of the animal, as he is to be treated on his feet, should be secured by supplementing the restraint of the twitch with that of the side-lines, and raising one of the hind legs.

(*e*) *Setons at the Thigh.*—These are prescribed in chronic swelling of the hind legs. The region they should cover extends from a level with a point a little below the inside of the ischial tuberosity to the superior third of the shank, and they should be placed in a slightly oblique direction from without inward. It is necessary while operating here, as in the hip-joint, to have the animal well secured, and not only the twitch and the side-lines, but sometimes the raising of one of the fore foot will be required; as of all setons, this is probably the most painful to insert, in consequence of the division of branches of the sciatic nerves, which lie in the course of the needle. The steps of the operation do not in any way vary from those in other regions, and therefore do not call for a redescription excepting perhaps to specify that in placing the tape the convexity of the blade must be turned inwardly, and an assistant will be needed to hold the tail aside. The tying of the tail to the surcingle on the opposite side of the body will prevent its becoming soiled with the discharge of the seton, and render the subsequent care of the patient easier.

(*f*) *Setons at the Stifle.*—This seton is recommended by Peuch and Toussaint in lameness of that region which has resisted vesicating liniments and blistering applications. They recommend the recumbent position for the safety of the operator. A convex bistoury and the ordinary seton-needle are required. The animal

while lying down has his hind leg extended by the traction made upon it by assistants with a rope. An incision is made above with the bistoury, and the needle introduced through it, it is pushed downward in front of the joint, carefully raising the skin as it progresses, to avoid injury of the femoro-patellar articulation.

(*g*) *Seton on the Abdomen.*—This seton is both difficult and dangerous to apply in the standing position, and, therefore, unless the animal is very carefully secured, and the operator unusually dexterous, it is better to have the animal cast. The seton placed on the median line, under the abdomen, extends from about the xyphoid cartilage back to near the sheath or other mammæ. In applying it, care must be taken to avoid injury to the tunica abdominalis and the abdominal muscles, or making a deep wound of the abdomen. Caution must also be exercised against the possibility of the animal kicking against the needle at the moment of its passage through the skin at the opening of exit. The tape when introduced in the eye of the instrument is to be drawn into the tract by pulling the needle away from behind forward.

(*h*) *Setons to the Neck.*—These are recommended against immobility and periodic ophthalmia. They are placed in an oblique direction, one or two, on one or both sides of the neck. The horizontal direction sometimes recommended is certainly quite unlikely to facilitate the free escape of pus. In introducing the needle it is better to direct it from below upward, starting at about the level of the convexity of the mastoido-humeralis muscle.

(*i*) *Setons on the Cheeks.*—These have been more or less advised in the treatment of diseases of the eyes, and principally of periodic ophthalmia. They are placed a little below the zygomatic spine, below and in front of the temporo-maxillary articulation, and extend downward some distance in front of the zygomatic crest. The blood vessels of that region, and principally the large nerves which cover the masseter muscles, must be carefully avoided, to guard against paralysis of the lip.

(*j*) *Setons in the Foot.*—The insertion of a seton in the foot, or the *frog-seton*, as it is also called, has been principally recommended in the treatment of navicular disease, though it is considered by many as of very doubtful utility. A special curved needle (see Fig. 222) is used for the purpose. The horse is in some instances kept in the standing position, while in some special cases it is better to have him thrown.

The shoe being removed, and the sole and frog pared down and made as thin as possible, either an incision may be made in the hollow of the heels, or the needle inserted without it through the skin, in such a direction as to have its point emerge at about the front part of the middle commissure of the frog. The tape is drawn into position by pulling the instrument straight away through the opening of exit. The seton is to be secured by tying ends together. When the operation is performed while the animal is standing, a strong assistant must hold the foot, and the needle pushed and passed through the frog rapidly, as by possible struggles, severe injuries of the tissues of the posterior part of the foot might result.

Rowel Seton.

This form of exutory is of earlier origin than the ordinary tape seton, and consists in a round piece of leather, felt or pasteboard, sometimes perforated in its center, which is deposited in a pouch

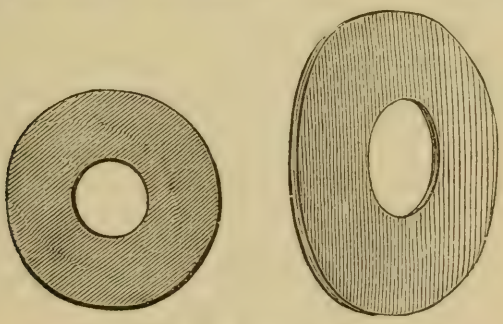


Fig. 224.—Rowel Seton.

made under the skin, either simple, or sometimes surrounded with a band of tape to prolong its continuance. It is principally used when the disposition of the parts renders the introduction of a tape seton difficult, or when it is for any reason contra-indicated, and especially when the exutory being indispensable to the well being of the patient, it is at the same time imperatively required that the animal shall be preserved free from any blemish or disfigurement. It is also to be preferred with animals which cannot be prevented from tearing out the ordinary tape seton with their teeth.

A pair of scissors and a straight bistoury are required for its insertion. A simple incision is made with the bistoury, long enough

to allow the introduction of the rowel, rolled or doubled on itself; then, with the scissors passed flatwise under the skin, a pouch is made, by dividing the cellular tissues, of sufficient dimensions to secure the rowel, which is to be opened or unrolled and flattened in the pouch in such a manner as to bring its central opening in correspondence with the incision in the skin.

This form of seton can remain for a period of from fifteen to twenty days, and there are cases where it has been kept in place as long as six weeks. It can easily be removed with the forceps or a pointed tenaculum.

Trochiscus.

This is an exutory formed of some mineral or vegetable substance, sometimes termed an issue pea, possessed of irritating or even caustic properties, which are introduced under the skin in the same manner as the rowel. They differ from the other exutories by causing a greater amount of irritation, a higher degree of inflammation, and for that reason are left in place for a shorter period, and are removed as soon as inflammatory symptoms are well established. They are less frequently used in solipeds, but are of more common employment in cattle. In the former, however, lameness of long standing in the upper segments of the legs has been successfully relieved by them. In cattle they are often inserted in the dewlap. They can be introduced directly under the skin, either through an incision made alone, or attached to a seton, which may continue longer in place after the removal of the trochiscus.

Accidents, Sequelæ of Setons.

The accidents which sometimes follow the application of setons are: hemorrhage, gangrenous swellings, abscesses, excessive granulations or fungosities, and indurations.

(*a*) *Hemorrhage.*—In ordinary circumstances, their introduction is accompanied by the escape of only a few drops of blood, but there are cases where abundant hemorrhages occur, either resulting from an injury to some blood vessels, or because of a special hemorrhagic predisposition in the animal, as when it is in a debilitated or anæmic state.

When there is hemorrhage, it usually shows itself at the conclusion of the operation, the blood oozing in drops from the open-

ings of the seton, or causing a swelling, if it accumulates in the tract. The ordinary means of hemostasis must be employed, as cold douches, iced lotions, etc., and if these fail, the seton must be removed, and the openings plugged with oakum, moistened with hemostatic liquids, or with absorbent cotton; or it may even be necessary to close the openings with sutures, or resort to the the application of pressure. Bouley recommended the introduction of a thick tent of oakum through the entire length of the tract.

(*b*) *Gangrenous Swellings.*—These are among the most common and dangerous of accidents accompanying setons, and occur principally during warm weather, in debilitated animals, or such as are exposed to bad hygienic conditions or affected with some special diseases.

The gangrene manifests itself by the appearance of a warm and painful swelling, œdematous and diffused, spreading rapidly, but in the central portion cold and painless, and a general reaction soon becomes manifest. The animal becomes dull; the pulse is accelerated and small, and the temperature heightened, the discharge of the setons has changed its character to that of a thin, sanious, and very fœtid suppuration. All these symptoms become rapidly exaggerated, and soon threaten the life of the patient, unless heroic measures are at once resorted to.

When the tract assumes this gangrenous aspect the tape must be immediately removed, and the tract thoroughly emptied and cleansed, by injections of antiseptic liquids such as solutions of phenic or salicylic acid, followed by cauterization with the red iron in the tract, and through the œdematous swelling, accompanied by the free administration of tonics and antiseptics internally. No means should be neglected likely to overcome the threatening septicæmia, which, if not controlled, will certainly have a fatal termination.

(*c*) *Abscesses.*—When the seton has been left in place too long, or there has been neglect in respect to the care and cleanliness of the tract, or when the tape has been removed, numerous abscesses will sometimes be found along the course of the seton. They have the character of phlegmonous swellings, and soon become fluctuating.

While they remain superficial, no serious results need be apprehended, and all they require is to be opened to allow the escape

of the pus, and to be treated generally after the manner of similar tumors in other parts of the body. But occasionally a filtration of the pus takes place between the different layers of tissues, and the abscesses become troublesome. To avoid their formation there must be a complete and regular evacuation of the tract by pressing out the contents once a day or oftener, according as the discharge requires it. To avoid the possibility of the migration of the pus and the formation of a deep abscess, the operator must be careful not to make a false tract with the needle during its passage under the skin.

(*d*) *Excessive Granulations or Fungosities.*—These often occur at the openings of the tract, when the tape has been left in place a long time. They are not of a serious character, and can be removed by excision or cauterization.

(*e*) *Indurations.*—These are also among the sequelæ of setons left in position too long, or when, after the removal of the tape, care has not been taken to press out and thoroughly empty the tract of any remaining portion of the discharge. These indurations appear in the form of long, hardened cords, extending more or less in the original length of the setons. They often disappear spontaneously, by a slow process of resorption, but in many cases it becomes necessary to have recourse to friction with alterative ointments composed of preparations of mercury or iodine. Deep pointed cauterization, or their entire removal by dissection are also recommended.

ABLATION OF TUMORS.

Under this heading are included the various modes of the division of tissues involved in the removal of tumors—a tumor being, as technically defined, a non-inflammatory mass, constituted by tissues of new formation, and having a tendency to persistency and possible growth.

The term *ablation*, of which the common definition is simply *taking away*, is in surgery employed to denote the excision or removal of tumors—a tumor being, in a surgical sense, any morbid, circumscribed enlargement affecting any of the structures or organs of the body, sometimes harmless, and sometimes malignant and fatal in their character and termination.

The surgical means at the disposal of the veterinarian, by which this operation is accomplished, are not so numerous as

those employed in human surgery, and can be comprehended in the four principal processes of excision, ligature, tearing and puncture. They are about equally employed, according to the circumstances and nature of the case, and the discretion of the operator.

1st.—Excision.

This mode of ablation can be performed in four ways, with the scissors, the bistoury, the ecraseur or the thermo-cautery.

(*a*) *With the Scissors.*—This is the simplest process, but is applicable only to tumors of diminutive size, such as warts, condyloma, and in general, to growths having a small and narrow peduncle. Curved scissors are generally used. The tumor is raised from the skin and secured with a pair of bull-dog forceps before the scissors are applied. The hemorrhage which may follow is not usually serious, and ordinarily requires no interference, and when necessary, can be readily controlled by means of cooling applications, pressure or cauterization.

(*b*) *With the Bistoury.*—When the tumor is comparatively small, with a narrow peduncle, its removal is effected in the same manner as with the scissors, the only change being in the stroke of the instrument. Usually a single stroke of the bistoury is sufficient. But if the tumor is of large dimensions and covered by the skin, the operation becomes more complicated and requires more time and care. It is ordinarily divided into three steps, viz.: the *incision of the skin, the dissection of the tumor, and its extirpation.*

The form and size of the incision must of course correspond to those of the tumor, which must be considered in reference to its basis, connections, adhesions and surrounding tissues, as well as the healthy or morbid condition of the teguments. The straight incision is applicable to subcutaneous tumors, free from adhesions or comparatively loose and susceptible of enucleation, while that made through a fold of the skin is better adapted to encysted growths, which it would be dangerous to open. The elliptic incision is used when a portion of the skin is to be removed, because of its being diseased or too thin, and its closing up would be too difficult; or when the extent of the skin exceeds that of the wound it covers. Crucial incisions, or those of the T or Y shape, are indicated when a tumor of large size is to be exposed,

while it is necessary to preserve the skin which covers it. Whatever form of incision may be used, it must always extend beyond the base of the tumor to allow a free dissection and an easy removal of all the diseased tissues. The convex bistoury is preferred in this step of an operation and must be applied with light pressure, and a very guarded motion, to avoid any subcutaneous blood vessels that may run over the surface of the growth, and which may be of large size.

The incision is followed by the dissection, which is done with the scalpel or the bistoury, by separating the tumor from the teguments, carefully avoiding surrounding structures, which should be held aside with the forceps or tenaculum, in order to keep the wound open and accessible. Instead of the scalpel or bistoury, the blunt end of the scissors sometimes becomes the instrument by which the adhesions of the cellular tissue covering the tumor are most easily destroyed.

In the third step, or the extirpation of the tumor, either the bistoury, the scalpel or the sage knife may be the most eligible instrument, according to the consistency of the tumor, whether hard, cartilaginous or bony If it is of sufficiently small size, by steadying it with the forceps or tenaculum, it may be excised with a single stroke of the instrument. If too large for this, it may be controlled by passing a loop of ribbon or tape through it, by which its position can be changed at pleasure, to facilitate its complete dissection. The hemorrhage following may be arrested by any of the usual hemostatic measures. When the tumor is of large dimensions this last step of the operation will require great care in the execution, and the blood vessels which may run through its base must be securely ligated before the tumor is entirely excised.

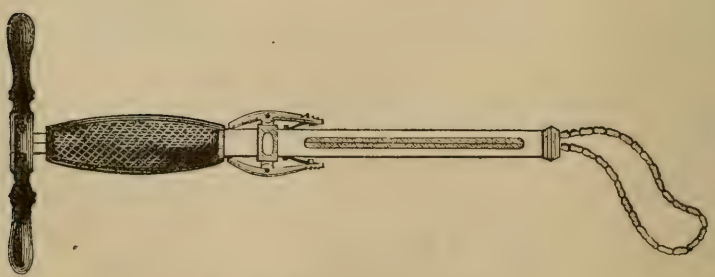


FIG. 225.—Ecraseur of Chassaignac.

(*c*) *With the Ecraseur.*—The instrument used in this method has received its name from the fact of its crushing action upon the tissues upon which it is applied and for which it was invented by Chassaignac. The original form of the instrument of Chassaignac has been subjected to various modifications, some being made to use with a chain alone, others to carry a wire, and others again to carry a chain or a wire alternately. Others like that of Reynal, of Miles, of Smith, and many others, vary also in shape or in size, but without differing in their general principles, and whether employed for the removal of tumors, or in special operations, as

FIG. 226.—Ecraseur with Chain.

FIG. 227.—Ecraseur with Wire.

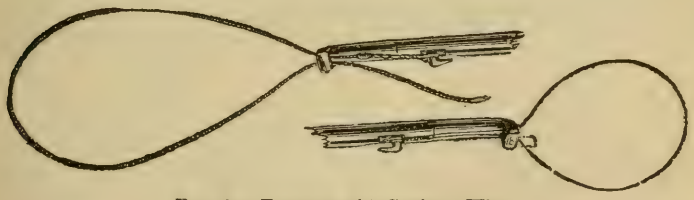


FIG. 228.—Ecraseur with Chain or Wire.

those of castrations in males, or spaying in females, the *modus operandi* remains the same. This consists in enclosing the base or peduncle of the tumor with the chain or wire of the instrument, and tightening it more or less rapidly at the discretion of the operator, by means of the screw in the handle until it is compressed, strangulated and crushed, and at last entirely separated. The action should be more or less gradual, according to the size of the parts and the consistency and vascularity of the tissues. A

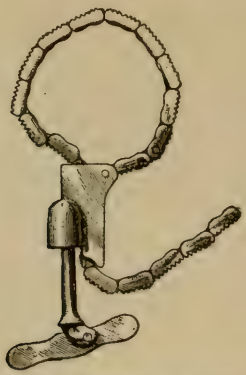


FIG. 229.—Ecraseur of Reynal.

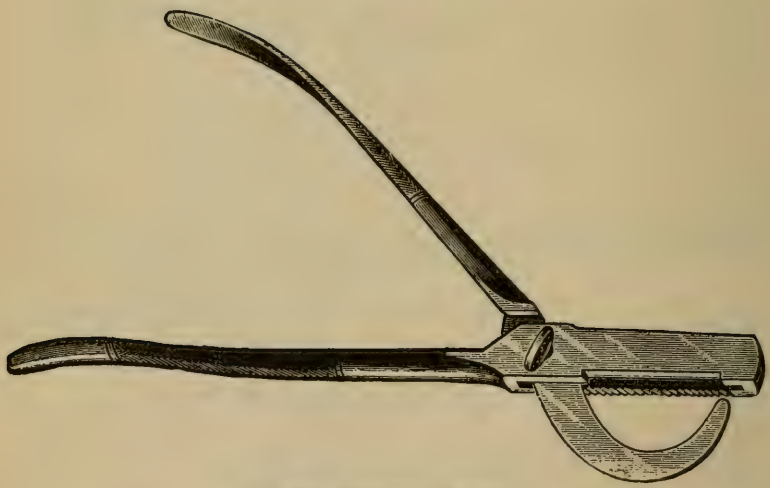


FIG. 229*a*.—Haussman Ecraseur.

slow movement of the ecraseur is essential to avoid hemorrhage, but although this rule is recommended by European authors, it does not seem to be as important as it is reported to be, if we may judge by the results obtained by American practitioners, in view of the manner in which they use this instrument in the operations of castration. Our experience, however, justifies a slow and careful application of the crushing process, especially in the removal of tumors where blood vessels of large size or in a state of disease may be known to ramify, and particularly in the ablations of the champignon of castration.

(*d*) *With the Thermo-Cautery.*—The ablation of tumors can also be performed with the flat platinum cautery of Paquelin, well heated, by following the same rules as with the bistoury, both when either the growths are small, or the incision of the skin and dissections of the tumor have been previously performed. The advantages gained by the use of the red-heated cautery in controlling the hemorrhage while the incision goes on, is too obvious and important to be ignored or depreciated.

2D.—LIGATURE.

The ligature operates on the tumor in its own peculiar and effective way, by circumscribing the base and depriving it of its nutriment by occluding the circulation and leaving it to undergo the process of gangrenous dissolution and sloughing, with the advantage of obviating any apprehended danger of subsequent hemorrhage. The kind of ligatures used for this purpose will vary with the choice of the practitioner. In veterinary surgery, the material is variously flax, hemp, silk, catgut, india rubber cords, or metallic wire. Whipcord or fishing line is often used, when a powerful constriction is to be applied, and their efficiency is increased by being waxed or soaped. There are various ways of applying a ligature, but they are all subject to the following rules: the size of the ligature must be proportioned to that of the parts to be ligated, and to their resistance; it ought to be applied only upon a limited portion of the tissues, and the skin ought never to be included, except when the peduncle is very narrow, or the skin already ulcerated.

First Method, Simple Ligature.—A cord or band is affixed around the base of the tumor, and tightly tied by a single knot. Sometimes the bleeding knot or double clove-hitch is preferred, drawn tightly and secured by a simple knot.

The mortification of the growth may be accelerated, if thought proper, by covering the ligature with some caustic preparation, such as an ointment of sulphide of arsenic, or also by adding to the effect of the ligature that of the actual cautery.

Second Method, Double Ligature. — This is brought into requisition when the peduncle of the tumor is too large to be easily embraced by a single ligature. It is made by piercing the base of the growth through the centre, by means of a straight

FIG. 230.—Tapestry Ligature.

needle with a double thread or cord, thus dividing the growth into separate halves, each having its own distinct ligature, tied on opposite sides of the peduncle.

Third Method, Multiple Ligature.—At times, the tumor may have a sufficiently wide base to require the addition of a third ligature in order to secure a sufficient amount of constriction to slough the entire mass, in which case special needles become necessary. These are longer than the ordinary ones, though more or less flexible, and with an eye in the centre, additional to that at the extremity, according to indications.

When the tumor is to be divided into three portions two needles are necessary, and a correspondingly long thread. The needles being passed together through the base of the tumor, with sufficient intervals between to divide it into three nearly equal

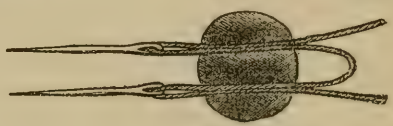


FIG. 231.—Treble Ligature.

parts, leave, when drawn through, three ligatures with which to enclose separately the central and two lateral portions of the peduncle.

If it becomes necessary to apply four ligatures, two different needles are necessary, one (female) long, having an eye in the

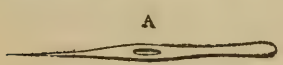


FIG. 232.—Female Needle.

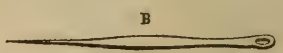


FIG. 233.—Male Needle.

centre, and another (male) of the ordinary form, with the eye at its extremity, but of a size which will permit its passage with a double thread through the central eye of the other. This male needle is to carry a long, double thread. The manipulation is very obvious. The first needle is inserted far enough to bring the central eye half way through the growth, and the second needle is passed through it, and out at the other side; then, drawing out the first, two double ligatures are left, or one for each quarter of the tumor. All that then remains is the tying of the four knots.

To describe it more in detail, the female needle is inserted in

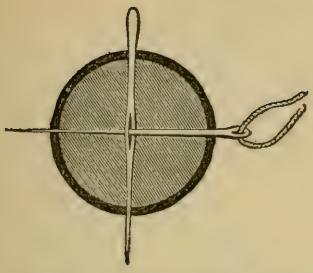


FIG. 234.—1st Step of the Ligature by Four.

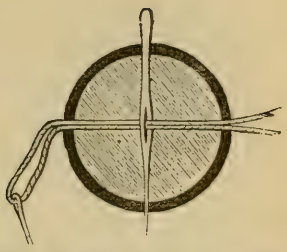


FIG. 235.—2d Step of the Ligature by Four.

the growth until the eye reaches the centre, when the male needle is introduced at a right angle with it, and passed through the eye, as in Fig. 234, to be drawn out on the opposite side of the tumor carrying the ligatures with it (Fig. 235).

In the second step of the operation, the passage of the male needle through the tumor with the double ligature is completed, and by the separation of the needle from one of the threads, two threads are left loose. The female needle is then pushed through the tumor, when one of the threads is cut off (Fig. 236); the fourth step being completed by having the female needle drawn back

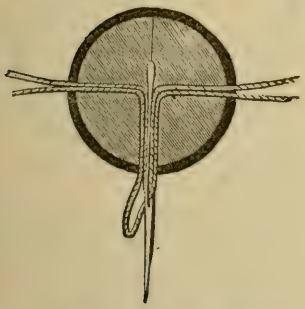


FIG. 236.—3d Step of the Ligature by Four.

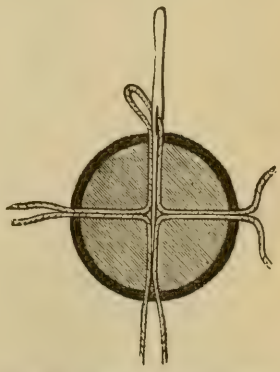


FIG. 237.—4th Step of the Ligature by Four.

through its original tract with the last threads or loop (Fig. 237), and when the needle is finally separated, it leaves the tumor divided into four segments by four threads, whose extremities are drawn and tightly secured by a single knot (Figs. 238, 239).

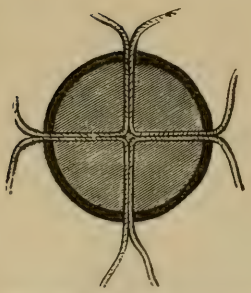


FIG. 238.—The Tumor divided in Four.

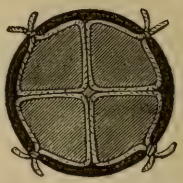


FIG. 239.—The Ligatures Secured.

Fourth Method, Subcutaneous Ligature.—This method is seldom practiced, as there are always objections to leaving under the skin the mortified structures divided by the constriction of the cord. But as there may be circumstances under which the growth cannot be immediately uncovered, its application becomes a question of necessity.

Three needles are required: one, A, straight and sharp; the second, B, straight and pointed; the third, C, curved and also pointed. These are placed upon a single long thread.

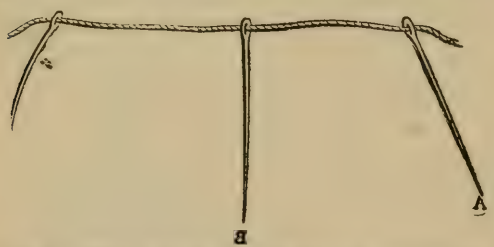


FIG. 240.—Thread and Needles for Subcutaneous Ligatures.

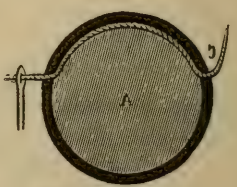


FIG. 241.—1st Step.

The growth A being subcutaneous, and spherical in shape, a vertical cutaneous fold is raised above its superior third, through the base of which the needle A is introduced. Leaving the fold loose, and the skin resuming its position, a first portion of ligature is found in place, under the teguments, surrounding one-third of the circumference at C (Fig. 241). The curved needle, C, is then passed through the tumor, entering at C, and coming out at B, with the loop D, and at B the needle is removed (Fig. 242).

By these first steps of the operation, the superior third of the growth is surrounded by the loop of thread B, C, D, both of whose

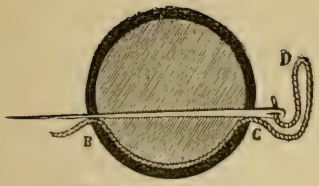


FIG. 242.—2d Step.

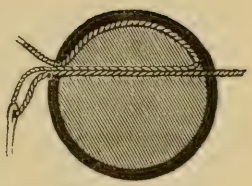


FIG. 243.—3d Step.

extremities come out by the same opening (Fig.. 243), while a second thread, f f, is free between the superior and the two lower thirds of the tumor (Fig. 244).

The manipulations for the superior third of the growth are repeated for the lower third, with another thread, and the middle third is then surrounded by two parallel threads A, B and C, D (Fig. 245).

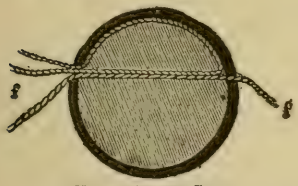


FIG. 244.—4th Step.

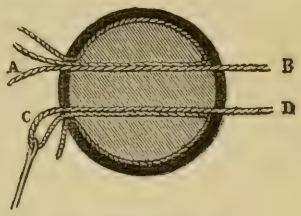


FIG. 245.—5th Step.

Both of these two threads are passed into the curved needle, and it then becomes easy to carry under the skin the extremity of the thread B to the opening D, and the thread A to the opening C, where it will be tied to thread B. All the threads A, B, C, D will thus form a loop embracing the middle third of the growth, as the other threads will surround the upper and the lower thirds. All the ligatures can be then tied to the required degree and the operation is completed (Figs. 246, 247).

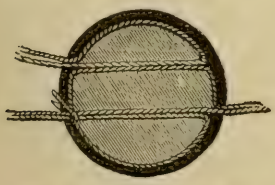


FIG. 246.—The Ligatures in Position.

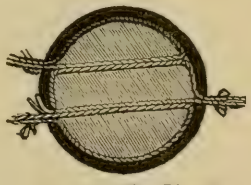


FIG. 247.—The Ligature Secured.

When the ligature that is to apply the necessary constriction upon the base of the tumor is in place, it must be tied more or

less suddenly and firmly, but never with sufficient force to produce an immediate section, an operation which could have been more easily performed, and with less pain, with the bistoury. To avoid this section, apply the constriction slowly, and in accordance with the effects produced, and the resistance encountered by the ligature. If the tissues are soft and frangible, it would be unsafe to complete the constriction at once, and it should be deferred to a later period; if, on the contrary, it is hard and resisting, the ligature may be drawn tightly, and firmly tied at once. Ordinary traction on the ligature may be made with the hands only, but when extra strong and steady traction is required, wooden holders will prove of great assistance. These means of securing the ligature on the tumor are successful so long as it is comparatively superficial, but if it is situated at a certain depth, special instruments are required. Among these is one particularly adapted to the removal of growths from the natural cavities, such as the nasal, rectal, vaginal or inguinal regions. It consists of a wooden or metallic tube, of variable length, through which the loop of a double, strong, waxed ligature can be introduced into the cavity

FIG. 248.—Ligature Carrier.

and adjusted around the base of the tumor, and when in position, tightened by traction on the thread at the mouth of the tube, and so secured that the constriction can be maintained at any degree of tightness, and increased or relaxed at pleasure.

3D.—ELASTIC LIGATURE.

This is but a variation from the ordinary ligature, in which an india-rubber cord or tubing of suitable diameter is substituted for the other means of constriction. It is applied like the others at the base of the tumor, and secured in the same manner. The peculiarity of its action arises, of course, from its elasticity, the result of which is a constant unrelaxing, self-regulating constriction, which continues automatically until the ablation is effected.

The growth upon which the elastic ligature is applied soon begins to undergo changes, which may be at first unnoticeable.

But presently it becomes cooler, the skin becomes soft, flabby, and of a dark brownish color; the mass becomes dry and contracted, and in from fifteen to twenty days it drops off, leaving a wound which heals in the usual manner.

The use of this ligature is, we believe, principally advantageous for small growths, and we have obtained good results from it in the castration of medium or small-sized animals, as well as in the treatment of small and superficial tumors, as warts, and the like. But in respect to large growths, such as the fibromas of the elbow joint, from the enormous size of the wound which follows, and the excessive length of time this requires to heal, we cannot feel justified in recommending it in similar cases.

4TH.—REMOVAL BY TEARING.

This is a method of extirpating tumors by mere force, grasping them with one hand or with the forceps, and with the other they are simply—with a twisting motion—torn from their connection. Of course it can only be practiced on small growths, but it has the advantage of preventing hemorrhage, and can be performed with the hands alone, or with the assistance of special forceps or nippers. The principal objection is that it sometimes fails to remove the fundamental element of the growth, and a renewal of the trouble may be looked for.

5TH.—PUNCTURE.

This subject has already been partially considered. It is performed with either the bistoury, the lancet, or the trocar, but it is principally applicable to soft tumors only, and as by its unaided action it is ordinarily insufficient to effect their complete disappearance, it becomes necessary to resort to instrumental help, in which cauterization with the pointed red iron, blistering applications, or the injection of irritating or modifying compounds, as solution of tincture of iodine, become the efficient adjuncts, if not in truth the actual curatives.

CHAPTER VI.

OPERATIONS ON BONES.

FRACTURES.

In technical language a fracture is a "solution of continuity in the structure or substance of a bone," and it ranks among the most serious of the lesions to which the horse—or any animal—can be subject. It is a subject of special interest to veterinarians, and to horse owners as well, in view of the variety of forms in which it may occur, as well as of the loss of time to which it subjects the patient, and the consequent suspension of his earning capacity. Though of less serious consequence in the horse than in man, it is always a matter of grave import. It is always slow and tedious in healing, and is frequently of doubtful and unsatisfactory result.

FIG. 249.—Complete Fracture.

This solution of continuity may take place in two principal ways. In the most numerous instances it includes the total thickness of the bone and is a *complete* fracture. In other cases it involves a portion only of the thickness of the bone, and for that reason is described as *incomplete* (Fig. 250). If the bone is divided into two separate portions, and the soft parts have received no injury, the fracture is a *simple* one; or it becomes *compound* if the soft parts have suffered laceration, and *comminuted* if the bones have been crushed or ground into fragments, many or few. The direction of the break also determines its further classification. Broken at a right angle, it is *transverse* (Fig. 251); at a different angle it becomes *oblique*

FIG. 250. Incomplete Fracture.

(Fig. 252), and it may be *longitudinal* or lengthwise. In a complete fracture, especially of the oblique kind, there is a condition of great importance in respect to its effect upon the ultimate result of the treatment, in the fact that from various causes, such as muscular contractions or excessive motion, the bony fragments do not maintain their mutual coaptation, but become separated at the ends, and this fact has made it necessary to add another descriptive term in the words—*with displacement.* And this term again suggests its negative, and introduces the fracture *without displace-*

FIG. 251.—Transverse Fracture of the Radius.

FIG. 252.—Oblique Fracture of the Femur.

ment, when the facts justify this description. Again, a fracture may be *intra-articular* or *extra-articular*, as it extends within a joint or otherwise, and once more, *intra-periosteal*, when the periosteum remains intact. And, finally, there is no absolute limit to the use of descriptive terminology in the case.

The condition of displacement is largely influential in determining the question of treatment, and as affecting the final result of a case of fracture. This, however, is dependent npon its location or whether its seat be in one or more of the axes of the bone, in its length, its breadth, its thicknsss, or its circumference. An incomplete fracture may also be either simple or comminuted, the periosteum, in the latter case when it is intact, keeping the fragments together, the fracture in that case belonging to the intra-periosteal class. At times there is only a simple fissure or split in the bone, making a condition of much difficulty of diagnosis.

Two varieties of originating cause may be recognized in cases of fracture. They are the *predisposing* and the *occasional*. As to the first, different species of animals differ in the degree of their liability. That of the dog is greater than that of the horse, and, in horses, the various questions of age, the mode of labor, the season of the year, the portion of the body most exposed, and the existence of ailments, local and general, are all to be taken into account.

Among horses, those employed in heavy draught work or that are driven over bad roads, are more exposed than light-draught or saddle horses, and animals of different ages are not equally liable. Dogs and young horses, with those which have become sufficiently aged for their bones to have acquired an enhanced degree of frangibility, are more liable than those which have not exceeded the time of their adult prime. The season of the year is undoubtedly, though in an incidental way, an important factor in the problem of the etiology of these accidents, for though they may be observed at all times, it is during the months when the slippery condition of the icy roads renders it difficult for both men and beasts to keep their feet, that they occur most frequently. The long bones, those especially which belong to the extremities, are most frequently the seat of fractures, from the circumstance of their superficial position; their exposure to contact and collision, and the violent muscular efforts involved both in their constant rapid movement and their labor in the shafts or at the pole of heavy and heavily laden carriages.

The relation between sundry idiosyncrasies and diatheses and a liability to fractures is too constant and well established a pathological fact to need more than a passing reference. The history of rachitis, of melanosis, and of osteo-porosis, as related to an abnormal frangibility of the bones, is a part of our common medical knowledge. There are few persons who have not known of cases among their friends of frequent and almost spontaneous fractures, or at least of such as seem to be produced by the slightest and most inadequate violence, and there is no tangible reason for doubting an analogous condition in individuals of the equine constitution. Among local predisposing affections, mention must not be omitted of such bony diseases as caries, tuberculosis, and others of the same class.

Occasional or "efficient" causes of fracture are in most instances external traumatisms, as violent contacts, collisions, falls, etc., or sudden muscular contractions. These external accidents are various in their character, and are usually associated with quick muscular exertion. A violent, ineffectual effort to move too heavy a load; semi-spasmodic bracing of the frame to avoid a fall or resist a pressure; a quick jump to escape a blow; stopping too suddenly after speeding; struggling to liberate a foot from a rail—perhaps to be thrown in the effort—all these are familiar and easy examples of accidents happening hourly, by which our equine servants become sufferers. We may add to these the fracture of the bones of the vertebræ, occurring when a patient is cast for the purpose of undergoing a surgical operation, quite as much the result of muscular contraction as of a pre-existing diseased condition of the bones. A fracture occurring under these circumstances may be called with propriety *indirect*, while one which has resulted from a blow or a fall differently caused is of the *direct* kind.

The symptoms belonging to the existence of fracture vary according to the site of the lesion. In case of its being on a bone of the extremity there is irregularity in the performance of the functions of the apparatus to which the fractured bone belongs, and as a necessary consequence of the existing lesion, *lameness* more or less marked. If the broken bone belongs to one of the extremities, the impossibility of the performance of its natural function, in sustaining the weight of the body and contributing to the act of locomotion, is usually complete, though the degree of

powerlessness will vary according to the kind of fracture and the bone which is injured. For example, a fracture of the cannon bone without displacement, or of one of the phalanges which are surrounded and sustained by a complex fibrous structure, is, in a certain degree, not incompatible with some amount of resting of the foot. But, on the contrary, if the shank bone, or that of the forearm be the implicated member, it would be very difficult for the leg to exercise any agency whatever in the support of the body. And in a fracture of the lower jaw, it would be obviously futile to expect it to contribute materially to the mastication of food.

A fracture seldom occurs which is not accompanied with a degree of deformity, greater or less, of the region or the leg affected. This is due to the exudation of the blood into the meshes of the surrounding tissues and to the displacement which occurs between the fragments of the bones, with subsequently the swelling which follows the inflammation of the surrounding tissues. The character of the deformity will mainly depend upon the manner in which the displacement occurs.

In a normal state of things the legs perform their movements with the joints as their only centres or bases of action, with no participation of intermediate points, while with a fracture the flexibility and motion which will be observed at unnatural points are among the most strongly characteristic signs of the lesion. No one need be told that when the shaft of a limb is seen to bend midway between the joints, with the lower portion swinging freely, that the leg is broken. But there are still some conditions where the excessive mobility is not easy to detect with certainty. Such are the cases where the fracture exists in a short bone, near a movable joint, or in a bone of a region where several short and small bones are united in a group, or even in a long bone where its situation is such that the muscular covering prevents the visible manifestation of the symptom.

If the situation of a fracture precludes its discovery by means of this abnormal flexibility, other detective methods remain. And after all there is one decisive sign which, though it may not avail in every case, as it does not, is in cases where its testimony can be secured absolute and positive beyond question. This is *crepitation*, or the peculiar effect which is produced by the friction of the fractured surfaces one against another. Though discerned

by the organ of hearing, it can scarcely be called a sound, for the grating of the parts, as the rubbing takes place, is often more felt than heard, but there is no mistaking its import in cases favorable for the application of the test. The conditions in which it is not available are those of incomplete fracture, in which the mobility of the parts is lacking; and those in which the whole array of phenomena are usually obscure. To obtain the benefit of this pathognomonic sign requires deliberate, careful, and gentle manipulation. Sometimes the slightest movements will be sufficient for its development, after much rougher handling has failed to discover it. Perhaps the failure in the latter case is due to a sort of defensive spasmodic rigidity caused by the pain resulting from the rude interference.

More or less reactive fever is a usual accompaniment of a fracture, and an ecchymosis of the parts is but a natural occurrence, more easily discovered in animals possessing a light-colored and delicate skin than in those of the opposite character.

There are difficulties in the way of the diagnosis of an incomplete fracture, even sometimes when there is a degree of impairment in the function of locomotion, with evidences of pain and swelling at the seat of lesion. There should then be a careful examination for the evidences of a blow or other violence sufficient to account for the fracture, though very often a suspicion of its existence can only be converted into a certainty by a minute history of the patient if it can be obtained up to the moment of the occurrence of the injury. A diagnosis ought not to be hastily pronounced, and where good ground for suspicion exists it ought not to be rejected upon any evidence less than the best. Serious and fatal complications are too often recorded of the results following careless conclusions in similar cases, among which we may refer to one instance of a complete fracture manifesting itself in an animal during the act of rising up in his stall after a decision had been pronouuced that he had no fracture at all.

Fractures are of course liable to complications, those especially, from the nature of the case, which are of a traumatic character, such as extensive lacerations, tearing of tissues, punctures, contusions, etc. But unless these are in communication with the fracture itself, the indication is to treat them simply as independent lesions upon the other parts of the body. A traumatic emphysema will at times cause trouble, and abscesses,

more or less deep and diffused, may follow. In some cases small bony fragments from a comminuted fracture, becoming loose and acting as foreign bodies, may give rise to troublesome fistulous tracts. A frequent complication is hemorrhage, which often becomes of serious consequence. A fracture in close proximity to a joint may be accompanied by dangerous inflammations of important organs, and may induce an attack of pneumonia, pleurisy, arthritis, etc., as well as luxations or dislocations, and the more so if situated near the chest. *Gangrene*, as a consequence of contusions or of hemorrhage or of an impediment to the circulation, caused by unskillfully applied apparatus, must not be overlooked among the occasional incidents; nor must *lockjaw*, which is not an uncommon occurrence. Even laminitis has been met with as the result of forced and long-continued immobility of the feet in the standing posture, as one of the involvements of unavoidably protracted treatment.

When a simple fracture has been properly treated, and the broken ends of the bone have been securely held in coaptation, one of two things will occur. Either—and this is the more common event—there will be a union of the two ends by a solid cicatrix, the callus, or the ends will continue separated or become only partially united by an intermediate fibrous structure. In the first instance the fracture is consolidated, or *united*, in the second there is a false articulation, or *pseudo-arthrosis*.

The time required for a firm union or true consolidation of a fracture will vary with the character of the bone affected, the age and constitution of the patient, and the general condition of the case. The union will be perfected earlier in a young than in an adult animal, and sooner in the latter than in the aged, and a general healthy condition is of course, in every respect, an advantage.

The mode of cicatrization, or method of repair in lesions of the bones, has been a subject of much study among investigators in pathology, and has elicited various expressions of opinion from those high in authority. But the weight of evidence and preponderance of opinion are about settled in favor of the theory that the law of reparation is the same for both the hard and the soft tissues. In one case a simple exudation of material, with the proper organization of newly formed tissue, will bring about a union by the first intention, and in another the work will be ac-

companied by suppuration, or the union by the second intention, a process so familiar in the repair of the soft structures by granulation.

Considering the process in its simplest form, in a case in which it advances without interruption or complication to a favorable result, it may probably be correctly described in this wise:

On the occurrence of the injury an effusion of blood takes place between the ends of the bone. The coagulation of the fluid soon follows, and this, after a few days, undergoes absorption. There is then an excess of inflammation in the surrounding structure, which soon spreads to the bony tissue, when a true ostitis is established, and the compact tissue of the bone becomes the seat of a new vascular organization, and of a certain exudation of plastic lymph,

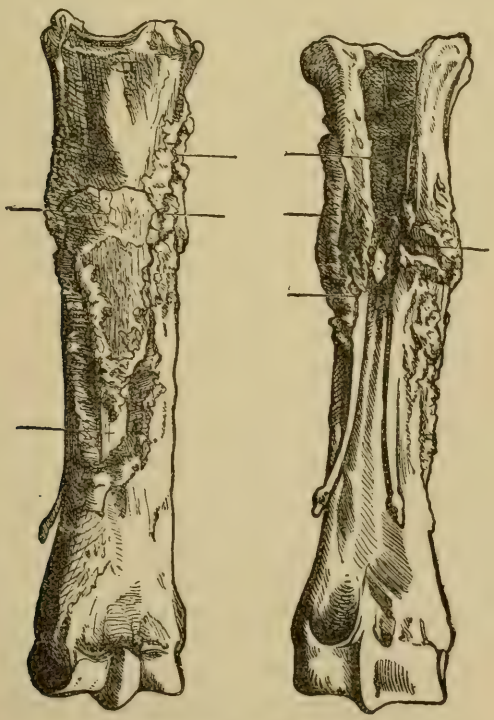


FIG. 253.—Fracture of the Common Bone, with Callus.

appearing between the periosteum and the external surface of the bone, as well as on the inner side of the medullary cavity. After a few days the ends of the bone thus surrounded by this exudate become involved in it, and the lymph, becoming vascular, is soon transformed into cartilaginous, and in due time into bony tissue.

Thus the time required for the consolidation of the fractured segments is divisible into two distinct periods. In the first they are surrounded by an external bony ring, and the medullary cavity is closed by a bony plug or stopper, constituting the period of the *provisional callus*. This is followed by the period of *permanent callus*, during which the process is going forward of converting the cartilaginous into the osseous form.

The restorative process is sooner completed in the carnivorous than in the herbivorous tribes. In the former the temporary callus may attain sufficient firmness or consistency for the careful use of the limb within four weeks, but with the latter a period of from six weeks to two months is not too long to allow before removing the supporting apparatus from the limb.

This in general terms represents the fact when the resources of nature have not been thwarted by untoward accidents, such as a want of vigor in the constitution of the patient or a lack of skill on the part of the practitioner, and especially when, from any cause, the bony fragments have not been kept in a state of perfect immobility and the constant friction has prevented the osseous union of the two portions. Failures and misfortunes are always more than possible, and instead of a solid and practicable bony union the sequel of the accident is sometimes a *false joint*, composed of mere flexible cartilage, a poor *pseudo-arthrosis*. The explanation of this appears to be that, first, the sharp edges of the ends of the bone disappear by becoming rounded at their extremities, by friction and polishing against each other. Then follows an exudation of a plastic nature, which becomes transformed into a cartilaginous layer of a rough articular aspect. In this, bony nuclei soon appear, and the lymph secreted between the segments thus transformed, instead of becoming truly ossified, is changed into a sort of fibro-cartilaginous pouch or capsular sac, in which a somewhat albuminous secretion, or pseudo-synovia, permits the movement to take place. Most commonly, however, in our animals, the union of the bony fragments is obtained wholly through the medium of a layer of fibrous tissue, and it is because

the union has been accomplished by a ligamentous formation only, that motion becomes practicable.

The prognosis in a case of fracture in an animal is one of the gravest vital import to the patient, and therefore of serious pecuniary concern to his owner. The period has not long elapsed when to have received such a hurt was quite equivalent to undergoing a sentence of death for the suffering animal, and perhaps to-day a similar verdict is pronounced in many cases in which the exercise of a little mechanical ingenuity, with a due amount of careful nursing, might secure a contrary result and insure the return of the patient to his former condition of soundness and usefulness. Considered *per se*, a fracture in an animal is in fact no less amenable to treatment than the same description of injury in any other living being. But the question of the propriety and expediency of treatment is dependent upon certain specific points of collateral consideration.

First. The nature of the lesion itself is a point of paramount importance. A simple fracture occurring in a bone where the ends can be firmly secured in coaptation, presents the most favorable conditions for successful treatment. If it be that of a long bone it will be the less serious if situated at or near the middle of its length than if it were in close proximity to a joint, from the fact that perfect immobility can rarely, in the latter case, be secured without incurring the risk of subsequent rigidity of the joint.

A simple is always less serious than a compouud fracture. A comminuted is always more dangerous than a simple, and a transverse break is easier to treat than one which is oblique. The most serious are those which are situated on parts of the body in which it is difficult to secure perfect immobility, and especially those which are accompanied by severe contusions and lacerations in the soft parts; the protrusion of fragments through the skin; the division of blood vessels by the broken ends of the bone; the existence of an articulation near the point to which inflammation is likely to extend; the luxation of a fragment of the bone; laceration of the periosteum; the presence of a large number of bony particles, the result of the crushing of the bone—all these are circumstances which discourage a favorable prognosis, and weigh against the hope of saving the patient for future usefulness.

Fractures which may be accounted curable are those which are

not conspicuously visible, as those of the ribs, where displacements are either very limited or do not occur, the parts being kept *in situ* by the nature of their position, the shape of the bones, the articulations they form with the vertebræ, the sternum, or their cartilages of prolongation; those of transverse processes of the lumbar vertebræ; those of the bones of the face; those of the ilium, and that of the coffin bones. To continue the category, they are evidently curable when their position and the character of the patient contribute to aid the treatment. Those of the cranium, in the absence of cerebral lesions; those of the jaws, of the ribs, with displacement, of the hip, and those of the bone of the leg in movable regions, but where their vertical position admits of perfect coaptation.

On the contrary, a compound, complicated, or comminuted fracture, in whatever region it may be situated, may be accounted incurable.

In treating fractures, time is an important element and "delays are dangerous." Those of recent occurrence unite more easily and more regularly than older ones.

Second. As a general rule, fractures are less serious in animals of the smaller species than in those of more bulky dimensions. This *influence of species* will be readily appreciated when we realize that the difficulties involved in the treatment of the latter class have hardly any existence in connection with the former. The difference in weight and size, and consequent facility in handling, and making the necessary applications of dressings and other appliances for the purpose of securing the indispensable immobility of the parts, and usually a less degree of uneasiness in the deportment of the patients are considerations in this connection of great weight.

Third. In respect to the utilization of the animal, the most obvious point in estimating the gravity of the case in a fracture accident is the certainty of the total loss of the services of the patient during treatment—certainly for a considerable period of time, perhaps permanently. For example, the fracture of the jaw of a steer just fattening for the shambles will involve a heavier loss than a similar accident to a horse. Usually the fracture of the bones of the extremities in a horse is a very serious casualty, the more so proportionately as the higher region of the limb is affected. In working animals it is exceedingly difficult to treat a

fracture in such a manner as to restore a limb to its original perfection of movement. A fracture of a single bone of an extremity in a breeding stallion or mare will not necessarily impair their value as breeders. Other specifications under this head, though pertinent and more or less interesting, may be omitted.

Fourth. Age and temper are important factors of cure. A young, growing, robust patient, whose *vis vitæ* is active, is amenable to treatment which one with a waning constitution and past mature energies would be unable to endure, and a docile, quiet disposition will act co-operatively with remedial measures which would be neutralized by the fractious opposition of a peevish and intractable sufferer.

The fulfillment of three indications is indispensable in all fractures. The first is the reduction, or the replacement of the parts as nearly as possible in their normal position. The second is their retention in that position for a period sufficient for the formation of the provisional callus, and the third, which in fact is but an incident of the second, the careful avoidance of any accidents or causes of miscarriage which might disturb the curative process.

In reference to the first consideration, it must be remembered that the accident may befall the patient at a distance from his home, and his removal becomes the first duty to be attended to. Of course this must be done as carefully as possible. If he can be treated on the spot so much the better, though this is seldom practicable, and the method of removal becomes the question calling for settlement. But two ways present themselves—he must either walk or be carried. If the first, it is needless to say that every caution must be observed in order to obviate any additional pain for the suffering animal, and to avoid any aggravation of the injury. Led slowly, and with partial support if practicable, the journey will not always involve untoward results. If he is carried it must be by means of a wagon, a truck, or an ambulance; the latter being designed and adapted to the purpose, would, of course, be the preferable vehicle. As a precaution which should never be overlooked, a temporary dressing should first be applied. This may be so done as for the time to answer all the purpose of the permanent adjustment and bandaging. Without thus securing the patient, a fracture of an inferior degree may be transformed to one of the severest kind, and, indeed, a curable changed to an incurable injury. We recall a case in which a fast trotting

horse, after running away in a fright caused by the whistle of a locomotive, was found on the road limping with excessive lameness in the off fore leg, and walked with comparative ease some two miles to a stable before being seen by a surgeon. His immediate removal in an ambulance was advised, but before that vehicle could be procured the horse laid down, and upon being made to get upon his feet was found with a well-marked comminuted fracture of the os suffraginis, with considerable displacement. The patient, however, after long treatment, made a comparatively good recovery, and though with a large bony deposit, a ringbone, was able to trot among the forties.

The two obvious indications in cases of fracture are *reduction*, or replacement and *retention*.

In an incomplete fracture, where there is no displacement, the necessity of reduction does not exist. With the bone kept in place by an intact periosteum, and the fragments secured by the uninjured fibrous and ligamentous structure which surrounds them, there is no dislocation to correct. It is also at times rendered impossible by the seat of the fracture itself, by its dimensions alone, or by the resistance arising from the muscular contraction excited by the surgical manipulation. This is illustrated even in small animals, as in dogs, by the exceeding difficulty encountered in bringing the ends of a broken femur or humerus together, the muscular contraction being even in these animals sufficiently forcible to renew the displacement.

It is generally, therefore, only fractures of the long bones, and then at points not in close proximity to the trunk, that may be considered to be amenable to reduction. It is true that some of the more superficial bones, as those of the head, of the pelvis, and of the thoracic walls may in some cases require special manipulations and appliances for their retention in their normal positions, but the treatment of these and of a fractured leg cannot be the same.

The methods of accomplishing reduction vary with the features of each case, the manipulations being necessarily modified to meet changing circumstances. If the displacement is in the thickness of the bone, as in transverse fracture, the manipulation of reduction consists in applying a steady pressure upon one of the fragments, while the other is kept steady in its place, the object of the pressure being the re-establishment of the exact coincidence of the two bony surfaces. If the displacement has taken place at an

angle it will be sufficient in order to effect the reduction to press upon the summit or apex of the angle until its disappearance indicates that the parts have been brought into coaptation. This method is often practiced in the treatment of a fractured rib. In a longitudinal fracture, or when the fragments are pressed together by the contraction of the muscles to which they give insertion until they so overlap as to correspond by certain points of their circumference, the reduction is to be accomplished by effecting the movements of *extension*, *counter-extension*, and *coaptation*. Extension is accomplished by making traction upon the lower portion of the limb. Counter-extension consists in firmly holding or confining the upper or body portion in such a manner that it shall not be affected by the traction applied to the lower; in simpler language, holding it motionless against the force exercised in the extension. In other words, the operator, grasping the limb below the fracture, draws it down or away from the trunk, while he seeks, not to draw away, but simply to hold still the upper portion until the broken ends of bone are brought to their natural relative positions when the coaptation, which is thus affected, has only to be made permanent by the proper dressings to perfect the reduction.

In treating fractures in small animals the strength of the hand is usually sufficient for the required manipulations. In the fracture of a forearm of a dog, for example, while the upper segment is firmly held by one hand, the lower may be grasped by the other and the bone itself made to serve the purpose of a lever to bring about the desired coaptation. In such a case that is sufficient to overcome the muscular contraction and correct the overlapping or other malposition of the bones. If, however, the resistance can not be overcome in this mode, the upper segment may be committed to an assistant for the management of the counter extension, leaving to the operator the free use of both hands for the further manipulation of the case.

But if the reduction of fractures in small animals is an easy task it is far from being so when a large animal is the patient, whose muscular force is largely greater than that of several men combined. In such a case resort must be had not only to superior numbers for the necessary force, but in many cases to mechanical aids. A reference to the mode of proceeding in a case of fracture with displacement of the forearm of a horse will illustrate the

matter. The patient is first to be carefully cast, on the uninjured side, with ropes, or a broad leather strap about 18 feet long, passed under and around his body and under the axilla of the fractured limb and secured at a point opposite to the animal and toward his back. This will form the mechanical means of counter extension. Another rope will then be placed around the inferior part of the leg below the point of fracture, with which to produce extension, and this will sometimes be furnished with a block or pulleys, in order to augment the power when necessary; and there is, in fact, always an advantage in their use, on the side of steadiness and uniformity, as well as of increased power. It is secured around the fetlock or the coronet, or, what is better, above the knee and nearer the point of fracture, and is committed to assistants. The traction on this should be firm, uniform, and slow, without relaxing or jerking, while the operator carefully watches the process. If the bone is superficially situated he is able to judge, by the eye, of any changes that may occur in the form or length of the parts under traction, and discovering at the moment of its happening the restoration of symmetry in the disturbed region, he gently but firmly manipulates the place until all appearance of severed continuity have vanished. Sometimes the fact and the instant of restoration are indicated by a peculiar sound, or "click," as the ends of the bone slip into contact, to await the next step of the restorative procedure.

The process is the same when the bones are covered with thick muscular masses, excepting that it is attended with greater difficulties, from the fact that the finger must be substituted for the eye, and the taxis must take the place of the sight, and the result naturally becomes more uncertain.

It frequently happens that perfect coaptation is prevented by the interposition between the bony surfaces of substances, such as a small fragment of detached bone or a clot of blood, and sometimes the extreme obliquity of the fracture is the opposing cause, by permitting the bones to slip out of place. These are difficulties which can not always be overcome, even in small-sized animals, and still it is only when they are mastered that a correct consolidation can be looked for. Yet without it the continuity between the fragments will be by a deformed callus, the union will leave a shortened, crooked or angular limb, and a disabled animal.

If timely assistance can be obtained, and the reduction ac-

complished immediately after the occurrence of the accident, that is the best time for it. But if it cannot be attended to until inflammation has become established and the parts have become swollen and painful, time must be allowed for the subsidence of these symptoms before attempting the operation. A spasmodic muscular contraction, which sometimes interposes a difficulty, may be easily overcome by subjecting the patient to general anesthesia, and need not, therefore, cause any loss of time. A tendency to this may also be overcome by the use of sedatives and anti-phlogistic remedies.

The reduction of the fracture having been accomplished, the problem which follows is that of *retention*. The parts which have been restored to their natural position must be kept there, without disturbance or agitation, until the perfect formation of a callus, and it is here that ample latitude exists for the exercise of ingenuity and skill by the surgeon in the contrivance of the necessary apparatus. One of the most important of the conditions which are available by the surgeon in treating human patients is denied the veterinarian in the management of those which belong to the animal tribes. This is *position*. The intelligence of the human patient co-operates with the instructions of the surgeon, but with the animal sufferer there is a continual antagonism between the parties, and the forced extension and fatiguing position which must for a considerable period be maintained as a condition of restoration require special and effective appliances to insure successful results. To obtain complete immobility is scarcely possible, and the surgeon must be content to reach a point as near as possible to that which is unattainable. For this reason, as will subsequently be seen, the use of slings and the restraint of patients in very narrow stalls is much to be preferred to the practice sometimes recommended, of allowing entire freedom of motion by turning them loose in box stalls. Temporary and movable apparatus are not usually of difficult use in veterinary practice, but the restlessness of the patients and their unwillingness to submit quietly to the changing of the dressings render it obligatory to have recourse to permanent and immovable bandages, which should be retained without disturbance until the process of consolidation is complete.

The materials composing the retaining apparatus consist of oakum, bandages and splints, with an agglutinating compound

which forms a species of cement by which the different constituents are blended into a consistent mass to be spread upon the surface covering the locality of the fracture. Its components are black pitch, resin, and Venice turpentine, blended by heat. The dressing may be applied directly to the skin, or a covering of thin linen may be interposed. A putty made with powdered chalk and the white of an egg is recommended for small animals, though a mixture of sugar of lead and burnt alum with the albumen is preferred by others. Another formula is spirits of camphor, Goulard's extract and albumen. Another recommendation is to saturate the oakum and bandages with an adhesive solution formed with gum arabic, dextrine, flour paste, or starch. This is advised particularly for small animals. Dextrine mixed, while warm, with burnt alum and alcohol cools and solidifies into a stony consistency, and is preferable to plaster of Paris, which is less friable and has less solidity, besides being heavier and requiring constant additions as it becomes older. Starch and plaster of Paris form another good compound.

In applying the dressing the leg is usually padded with a cushion of oakum, thick and soft enough to equalize the irregularities of the surface and to form a bedding for the protection of the skin from chafing. Over this the splints are placed. The material for these is, variously, pasteboard, thin wood, bark, laths, gutta percha, strips of thin metal, as tin or perhaps sheet iron. These should be of sufficient length not only to cover the region of the fracture, but to extend sufficiently above and below to render the immobility more complete than in the surrounding joints. The splints again, are covered with cloth bandages, linen preferably, soaked in a glutinous moisture. These bandages are to be carefully applied, with a perfect condition of lightness. They are usually made to embrace the entire length of the leg, in order to avoid the possibility of interference with the circulation of the extremity, as well as for the prevention of chafing. They should be rolled from the lower part of the leg upward, and carefully secured against loosening. In some instances suspensory bandages are recommended, but excepting for small animals our experience does not justify a concurrence in the recommendation.

These permanent dressings always need careful watching in reference to their immediate effect upon the region they cover,

especially during the first days succeeding that of their application. Any manifestation of pain, or any appearance of swelling above or below, or any odor suggestive of suppuration should excite suspicion, and a thorough investigation should follow without delay. The removal of the dressing should be performed with great care, and especially so if time enough has elapsed since its application to allow of a probability of a commencement of the healing process or the existence of any points of consolidation. With the original dressing properly applied in its entirety in the first instance, the entire extremity will have lost all chance of mobility, and the repairing process may be permitted to proceed without interference. There will be no necessity and there need be no haste for removal or change except under such special conditions as have just been mentioned, or when there is reason to judge that solidification has become perfect, or for the comfort of the animal, or for its readaptation in consequence of the atrophy of the limb from want of use. Owners of animals are often tempted to remove a splint or bandage prematurely at the risk of producing a second fracture in consequence of the failure of the callus properly to consolidate.

The method of applying the splints which we have described refers to the simple variety only. In a compound case the same rules must be observed, with the modification of leaving openings through the thickness of the dressing, opposite the wound, in order to permit the escape of pus and to secure access to the points requiring the application of treatment.

Fracture of different Bones.

Of the Cranial Bones.—Fractures of this variety in large animals are comparatively rare, though the records are not destitute of cases. When they occur, it is as the result of external violence, the sufferers being usually runaways which have come in collision with a wall or tree, or other obstruction; or it may occur in those which in pulling upon the halter have broken it with a jerk and been thrown backward, as might occur in rearing too violently. Under these conditions we have witnessed fractures of the parietal, of the frontal, and of the sphenoid bones. These fractures may be of the complete or incomplete kind, which indeed is usually the case with those of the flat bones, and they are liable to be complicated with lacerations of the skin, in conse-

quence of which they are easily brought under observation. But when the fact is otherwise and the skin is intact, the diagnosis becomes difficult. The incomplete variety may be unaccompanied by any special symptoms, but in the complete kind one of the bony plates may be so far detached as to press upon the cerebral substance with sufficient force to produce serious nervous complications. When the injury occurs at the base of the cranium, hemorrhage may be looked for, with paralytic symptoms, and when these are present the usual termination is death. It may still happen, however, that the symptoms of an apparently very severe concussion may disappear, with the result of an early and complete recovery, and the surgeon will do well to avoid undue precipitation in venturing upon a prognosis. In fractures of the orbital or the zygomatic bones the danger is less pressing than with injuries otherwise located about the head. The treatment of cranial fractures is simple, though involving the best skill of the experienced surgeon. When incomplete, hardly any interference is needed; even plain bandaging may usually be dispensed with. In the complete variety the danger to be combated is compression of the brain, and attention to this indication must not be delayed. The means to be employed are the trephining of the skull over the seat of the fracture, and the elevation of the depressed bone or the removal of the portion which is causing the trouble. Fragments of bone in comminuted cases, exfoliations, collections of fluid, or even protruding portions of the brain substance must be cleansed away, and a simple bandage so applied as to facilitate the application of subsequent dressings.

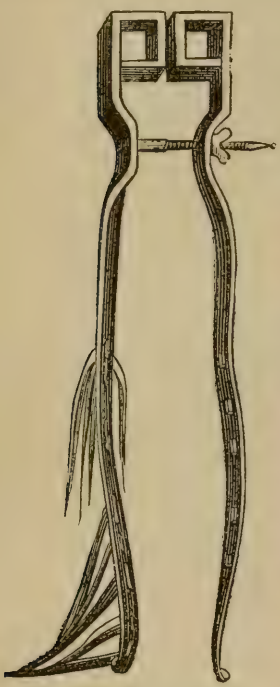


FIG. 254.—Apparatus for Fracture of the Nasal Bone.

Fractures of the Bones of the Face.—In respect to their origin—usually traumatic—these injuries rank with the preceding, and are commonly of the incomplete variety. They may easily be over-

looked and may even sometimes escape recognition until the reparative process has been well established and the discovery of the wound becomes due to the prominence caused by the presence of the provisional callus which marks its cure. When the fracture is complete it will be marked by local deformity, mobility of the fragments, and crepitation. Nasal hemorrhage, roaring, frequent sneezing, loosening or loss of teeth, difficulty of mastication, and inflammation of the cavities of the sinuses are varying complications of these accidents. The object of the treatment should be the restoration of the depressed bones as nearly as possible to their normal position, and their retention in place by protecting splints, which should cover the entire facial region (Figs. 254, 255),

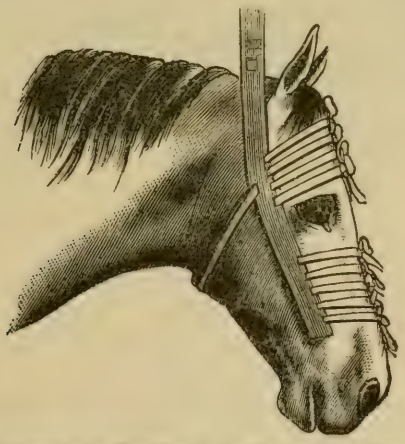


FIG. 255.—Apparatus for Fracture of the Bones of the Face Applied.

and special precautions should be observed to prevent the patient from disturbing the dressing by rubbing his head against surrounding objects, such as the stall, the manger, the rack, etc. Clots of blood in the nasal passages must be washed out, collections of pus must be removed from the sinuses, and if the teeth are loosened and likely to fall out, they should be removed. If roaring is threatened, tracheotomy is indicated.

Fractures of the Pre-Maxillary Bone.—These are mentioned by continental authors. They are usually encountered in connection with fractures of the nasal bone, and may take place either in the width or length of the bone.

The deformity of the upper lip, which is drawn sideways in

this lesion, renders it easy of diagnosis. The abnormal mobility and the crepitation, with the pain manifested by the patient when undergoing examination, are concurrent symptoms. Looseness of the teeth, abundant salivation, and entire inability to grasp the food complete the symptomatology of these accidents. In the

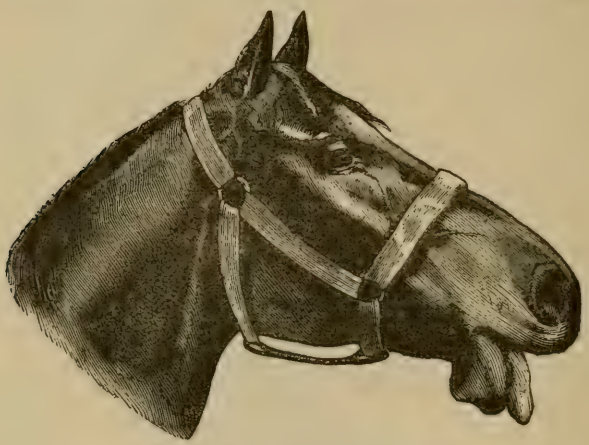


FIG. 256.—Fracture of the Lower Jaw.

treatment, splints of gutta percha or leather are sometimes used, but they are of difficult application. Our own judgment and practice are in favor of the union of the bones by means of metallic sutures.

The Lower Jaw.—A fracture here is not an injury of infrequent occurrence. It involves the body of the bone, at its symphysis, or back of it, and includes one or both of its branches, either more or less forward, or at the posterior part, near the temporo-maxillary articulation, at the coronoid process.

Falls, blows, or other external violence, or powerful muscular contractions during the use of the speculum, may be mentioned among the causes of this lesion. The fracture of the neck and of the branches in front of the cheeks cause the lower jaw, the true dental arch, to drop without the ability to raise it again to the upper, and the result is a peculiar and characteristic physiognomy (Fig. 256.) The prehension and mastication of food become impossible; there is an abundant escape of fetid and sometimes bloody saliva, especially if the gums have been wounded; there is excessive mobility of the lower end of the jawbone; and there is

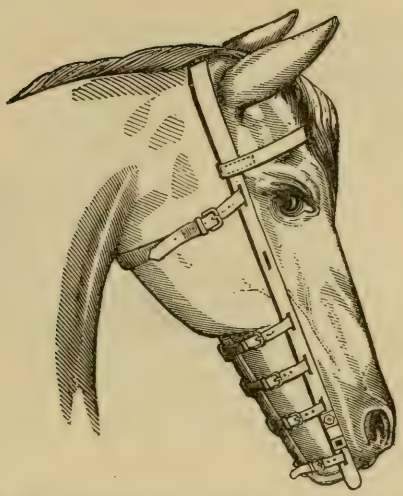


FIG. 257.—Splint for Fracture of the Lower Maxillary.

crepitation, and frequently paralysis of the under lip. But although the aspect of an animal suffering with a complete and often compound and comminuted fracture of the submaxilla presents at times a frightful spectacle, the prognosis of the case is comparatively simple, and recovery usually only a question of time. The severity of the lesion corresponds in degree with that of the violence to which it is due, the degree of simplicity or the amount of complication, and with the situation of the wound. It is simple when at the symphysis, but becomes more serious when it affects one of the branches, to be again aggravated when both are involved. Fracture of the coronoid process becomes important principally as an evidence of the existence of a morbid diathesis, such as osteoporosis, or the like.

The particular seat of the injury, with its special features, will of course determine the treatment. For a simple fracture without displacement, provided there is no laceration of the periosteum, an ordinary supporting bandage will usually be sufficient. But when there is displacement the reduction of the fracture must first be accomplished, and for this special splints are necessary. In a fracture of the symphysis or of the branches the adjustment of the fragments by securing them with metallic sutures is the first step necessary, to be followed by the application of supports, consisting of splints of leather or sheets of metal (Fig. 258 and 259), the entire

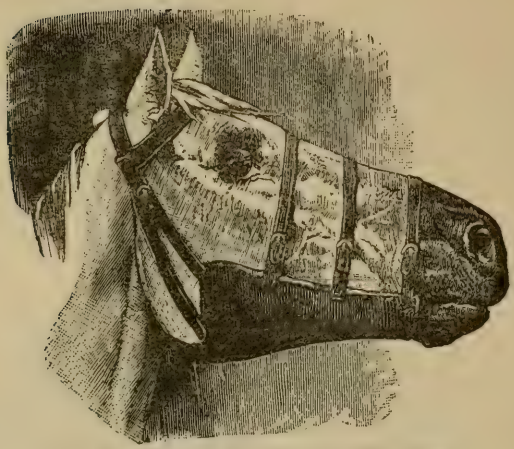


FIG. 258.—Splint, for Fracture of the Branches.

front of the head being then covered with bandages prepared with adhesive mixtures. During the entire course of treatment a special method of feeding becomes necessary. The inability of the patient to appreciate the situation of course necessitates a resort to an artificial mode of introducing the necessary food into his stomach, and it is accomplished by forcing between the commissures of the lips, in a liquid form, by means of a syringe, the milk or

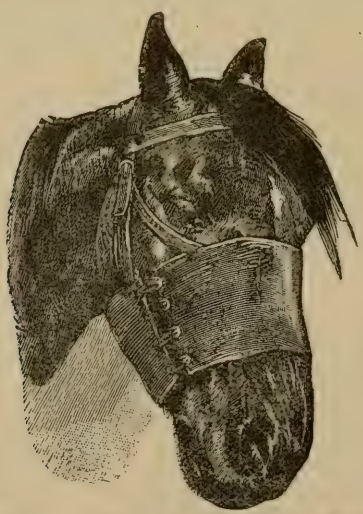


FIG. 259.—Another Splint for Fracture of the Maxillary.

nutritive gruels selected for his sustenance, until the consolidation is sufficiently advanced to permit the ingestion of food of a more solid consistency. The callus will usually be sufficiently hardened in two or three weeks to allow of a change of diet to mashes of cut hay and scalded grain, until the removal of the dressing restores him to his old habit of mastication.

Fractures of vertebræ.—These are not very common, but when they do occur the bones most frequently injured are those of the back and loins. The ordinary causes of fracture are responsible here as elsewhere, such as heavy blows on the spinal column, severe falls while conveying heavy loads, and especially violent efforts in resisting the process of casting. Although occurring more or less frequently under the latter circumstances, the accident is not always attributable to carelessness or error in the management. It may, of course, sometimes result from such a cause as a badly prepared bed, or the accidental presence of a hard body concealed in the straw, or to a heavy fall when the movements of the patient have not been sufficiently controlled by an effective apparatus and its skillful adaptation, but it is quite as likely to be caused by the violent resistance and the consequent powerful muscular contraction by the frightened patient. The simple fact of the overarching of the vertebral column, with excessive pressure against it from the intestinal mass, owing to the spasmodic action of the abdominal muscles, may account for it, and so also may the struggles of the animal to escape from the restraint of the hobbles while frantic under the pain of an operation without anæsthesia. In these cases the fracture usually occurs in the body or the annular part, or both, of the posterior dorsal or the anterior lumbar vertebra. When the tranverse processes of the last-named bones are injured, it is probably in consequence of heavy concussion incident to striking the ground when cast. Diagnosis of a fracture of the body of a vertebra is not always easy, especially when quite recent, and more especially when there is no accompanying displacement. There are certain peculiar signs accompanying the occurrence of the accident while an operation is in

FIG. 260.—Fracture of the Body of a Dorsal Vertebræ.

FIG. 261.—United Fracture of the Spinous Processes of Dorsal Vertebræ.

FIG. 261*a*.—Comminuted Fracture of a Dorsal Vertebræ at the Annular Portion.

progress which should at once excite the suspicion of the surgeon. In the midst of a violent struggle the patient becomes suddenly quiet; the movement of a sharp instrument which at first excited his resistance fails to give rise to any further evidence of sensation; perhaps a general trembling, lasting for a few minutes, will follow, succeeded by a cold, profuse perspiration, particularly between the hind legs, and frequently there will be micturition and defecation. Careful examination of the vertebral column may then detect a slight depression or irregularity in the direction of the spine, and there may be a diminution or loss of sensation in the posterior part of the trunk while the anterior portion continues to be as sensitive as before. In making an attempt to get upon his feet, however, upon the removal of the hobbles, only the fore part of the body will respond to the effort, a degree of paraplegia being present, and while the head, neck, and fore part of the body will be raised, the hind quarters and hind legs will remain inert. The animal may perhaps succeed in rising and probably may be re-

FIG. 262.—Fracture of the Axis in an Animal Suffering with Osteo-Porosis.

moved to his stall, but the displacement of the bone will follow, converting the fracture into one of the complete kind, either through the exertion of walking or by a renewed attempt to rise after another fall, before reaching his stall. By this time the paralysis is complete, and the extension of the meningitis which has become established is a consummation soon reached.

To say that the prognosis of fracture of the body of the vertebræ is always serious is to speak very mildly. It were better, perhaps, to say that *occasionally* a case *may* recover. Fractures of the transverse processes are less serious.

Instead of stating the indication in this class of cases, as if assuming them to be medicable, the question naturally becomes rather a query: "Can any treatment be recommended in a fracture of the body of a vertebra?" The only indication in such a case, in our opinion, is to reach the true diagnosis in the shortest possible time and to act accordingly. If there is displacement, and the existence of serious lesions may be inferred from the nervous symptoms, the destruction of the suffering animal appears to suggest itself as the one conclusion in which considerations of policy, humanity, and science at once unite.

If, however, it is fairly evident that no displacement exists; that pressure upon the spinal cord is not yet present; that the animal with a little assistance is able to rise upon his feet and to walk a short distance, it may be well to experiment upon the case to the extent of placing the patient in the most favorable circumstances for recovery, and allow nature to operate without further interference. This may be accomplished by securing immobility

of the whole body as much as possible, and especially of the suspected region, by placing the patient in slings, in a stall sufficiently narrow to preclude lateral motion, and covering the loins with a thick coat of agglutinative mixture, and wait for developments.

Fracture of the Ribs.—The different regions of the chest are not equally exposed to the violence to which fractures of the ribs are due, and they are therefore either more common or more easily discovered during life at some points than at others. The more exposed regions are the middle and the posterior, while the front is largely covered and defended by the shoulder. A single rib may be the seat of fracture, or a number may be involved, and there may be injuries on both sides of the chest at the same time. It may take place lengthwise, in any part of the bone, though the middle, being the most exposed, is the most frequently hurt. Incomplete fractures are usually lengthwise, involving a portion only of the thickness, or one or other of the surfaces. The complete kind may be either transverse or oblique, and are most commonly

FIG. 263.—United Transversal and Longitudinal Fractures of the Ribs.

denticulated. The fracture may be comminuted, and a single bone may show one of the complete and one of the incomplete kind at different points. The extent of surface presented by the thoracic region, with its complete exposure at all points, explains the liability of the ribs to suffer from all forms of external violence.

In many instances fractures of these bones continue undiscovered, especially the incomplete variety, without displacement, though the evidences of local pain, a certain amount of swelling and a degree of disturbance of the respiration, if noticed during the examination of a patient, may suggest a suspicion of their existence. Abnormal mobility and crepitation are difficult of detection, even when present, and they are not always present.

When there is displacement the deformity which it occasions will betray the fact, and when such an injury exists the surgeon will, of course, become vigilant in view of possible and probable complications of thoracic trouble, and prepare himself for an encounter with a case of traumatic pleuritis or pneumonia. Fatal injuries of the heart are recorded. Subcutaneous emphysema is a common accompaniment of broken ribs, and we recall the death from this cause of a patient of our own, which had suffered a fracture of two ribs in the region of the withers under the cartilages of the shoulder, and of which the diagnosis was made only after the fatal ending of the case.

These hurts are not often of a very serious character, though the union is never as solid and complete as in other fractures, the callus being usually imperfect and of a fibrous character, with an amphiarthrosis formation. Still, complications occur which may impart gravity to the prognosis.

Fractures with but a slight or no displacement need no reduction. All that is necessary is a simple application of a blistering nature as a preventive of inflammation or for its subjugation when present, and in order to excite an exudation which will tend to aid in the support and immobilization of the parts. At times, however, a better effect is obtained by the application of a bandage placed firmly around the chest, although, while this limits the motion of the ribs, it is apt to render the respiration more labored.

If there is displacement with much accompanying pain and evident irritation of the lungs, the fracture must be reduced without delay. The means of effecting this vary according to whether the displacement is outward or inward. In the first case the bone may be straightened by pressure from without, while in the second the end of the bone must be raised by a lever, for the introduction of which a small incision through the skin and intercostal spaces will be necessary. When coaptation has been affected it must be retained by the external application of adhesive mixture, with splints and bandages around the chest.

Fractures of the bones of the pelvis will be considered under their separate denominations, as those of the *sacrum* and the *os innominata*, or the hip, which includes the subdivision of the ilium, the pubes, and the ischium.

The Sacrum.—Fractures of this bone are rarely met with among solipeds. Among cattle, however, it is of common occur-

rence, being attributed not only to the usual varieties of violence, as blows and other external hurts, but to the act of coition, and to violent efforts in parturition. It is generally of the transverse kind, and may be recognized by the deformity which it occasions. This is due to the dropping of the bone, with a change in its direction and a lower attachment of the tail, which also becomes more or less paralyzed. The natural and spontaneous relief which usually interposes in these cases has doubtless been observed by the extensive cattle breeders of the West, and their practice and example fully establishes the inutility of interference. Still, cases may occur in which reduction may be indicated, and it then becomes a matter of no difficulty. It is effected by the introduction of a round, smooth piece of wood into the rectum as far as the fragment of the bone, and using it as a lever, resting it upon another as a fulcrum placed under it outside. The bone having been thus returned may be kept in place by the ordinary external means in use.

The Os Innominata.—Fractures of the ilium may be observed either at the angle of the hip or at the neck of the bone; those of the pubes may take place at the symphysis, or in the body of the bone; those of the ischium on the floor of the bone, or at its posterior external angle. Or, again, the fracture may involve all three of these constituent parts of the hip bone by having its situation in the articular cavity—the acetabulum by which it joins the femur or thigh bone.

Some of these fractures are easily recognized, while others are difficult to identify. The ordinary deformity which characterizes a fracture of the external angle of the ilium, its dropping and the diminution of that side of the hip in width, unite in indicating the existence of the condition expressed by the term "hipped." But an incomplete fracture, or one that is complete without displacement, or even one with displacement, often demands the closest scrutiny for its discovery. The lameness may be well marked, and an animal may show but little appearance of it while walking, but upon being urged into a trot will manifest it more and more, until presently he will cease to use the crippled limb altogether, and perform his traveling entirely on three legs. The acute character of the lameness will vary in degree as the seat of the lesion approximates the acetabulum. In walking, the motion at the hip is very limited, and the leg is dragged, while at rest it is relieved from bearing its share in sustaining the body. An intelligent

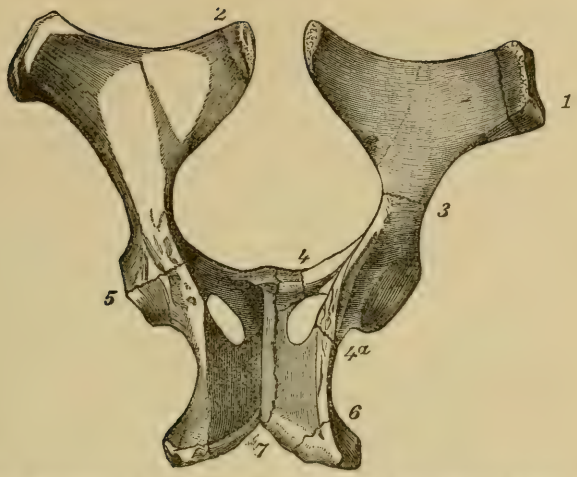


FIG. 264.—Fractures of the Ossa Innominata: 1, at the external angle; 2, at the internal angle; 3, at the neck of the ilium; 4, at the body of the pubis; 4*a*, at the antero-external angle of the ischium; 5, at the cotyloid cavity; 6, at the postero-external angle of the ischium; 7, at the symphysis pubis.

opinion and correct conclusion will depend largely upon a knowledge of the history of the case, and while in some instances that will be but a report of the common etiology of fractures, such as blows, hurts, and other external violence, the simple fact of a fall may furnish a satisfactory solution of the whole matter.

With the exception of the deformity of the illum in a fracture of its external angle, and unless there has been a serious laceration of tissues and infiltration of blood, or excessive displacement, there are no very definite external symptoms in a case of a fracture of the hip bone. There is one, however, which, in a majority of cases, will not fail—it is crepitation. This evidence is attainable by both external and internal examination—by manipulation of the gluteal surface and by rectal taxis. Very often a lateral motion, or balancing of the hinder parts by pressing the body from one side to the other, will be sufficient to render the crepitation more distinct—a slight sensation of grating, which may be perceived even through the thick coating of muscle which covers the bone—and the sensation may not only be felt, but to the ear of the expert may even become audible. This external manifestation is, however, not always sufficient in itself, and should always be associated with the rectal taxis for corroboration. It is true that this may fail to add to the evidence of fracture, but till then the simple testimony afforded

by the detection of crepitation from the surface, though a strong confirmatory point, is scarcely sufficiently absolute to establish more than a reasonable probability or strong suspicion in the case.

In addition to the fact that the rectal examination brings the exploring hand of the surgeon into near proximity to the desired point of search, and to an accurate knowledge of the situation of parts, both *pro* and *con* as respects his own views, there is another advantage attendant upon it which is well entitled to appreciation. This is the facility with which he can avail himself of the co-operation of an assistant, who can aid him by manipulating the implicated limb and placing it in various positions, so far as the patient will permit, while the surgeon himself is making explorations and studying the effect from within. By this method he can hardly fail to ascertain the character of the fracture and the condition of the bony ends. By the rectal taxis, as if with eyes in the finger ends, he will "see" what is the extent of the fracture of the ilium or of the neck of that bone; to what part of the central portion of the bone (the acetabulum) it reaches; whether this is free from disease or not, and in what location on the floor of the pelvis the lesion is situated. We have frequently, by this method, been able to detect a fracture at the symphysis, which from its history and symptoms and an external examination, could only have been guessed at.

Yet, with all its advantages, the rectal examination is not always necessary, as, for example, when the fracture is at the posterior and external angle of the ischium, when by friction of the bony ends the surgeon may discern the crepitation without it.

Every variety of complication, including muscular lacerations with the formation of deep abscesses and injuries to the organs of the pelvic cavity, the bladder, the rectum, and the uterus, may be associated with fractures of the hip bone.

The prognosis of these lesions will necessarily vary considerably. A fracture of the most superficial part of the bone of the ilium or of the ischium, especially where there is little displacement, will unite rapidly, leaving a comparatively sound animal often quite free from subsequent lameness. But if there is much displacement, only a ligamentous union will take place, with much deformity and more or less irregularity in the gait. Other fractures may be followed by complete disability of the patient, as, for example, when the cotyloid cavity is involved, or when the reparatory process has left bony deposits in the pelvic cavity at the seat of the union,

which may, with the female, interfere with the steps of parturition, or induce some local paralysis by pressure upon the nerves which govern the muscles of the hind legs. This is a condition not infrequently observed when the callus has been formed on the floor of the pelvis near the obturator foramen, pressing upon the course or involving the obturator nerve.

The treatment of all fractures of the hip bone should, in our estimation, be of the simplest kind. Rendered comparatively immovable by the thickness of the muscles by which the region is enveloped, one essential indication suggests itself, and that is, to place the animal in a position which, as far as possible, will be fixed and permanent. For the accomplishment of this purpose the best measure, as we consider it, is to place him in a stall of just sufficient width to admit him, and to apply a set of slings snugly, but comfortably. This will fulfill the essential conditions of recovery, rest, and immobility. Blistering applications would be injurious, though the adhesive mixture might prove in some degree beneficial.

The minimum period allowable for solid union in a fractured hip is, in our judgment, two months, and we have known cases in which that was too short a time.

As we have before said, there may be cases in which the treatment for fracture at the floor of the pelvis has been followed by symptoms of partial paralysis, the animal, when lying down, being unable to regain his feet, but moving freely when placed in an upright position. This condition is due to the interference of the callus with the functions of the obturator nerve, which it presses upon or surrounds. We feel warranted by our experience in similar cases in cautioning owners of horses in this condition to exercise due patience, and to avoid a premature sentence of condemnation against their invalid servants; they are not all irrecoverably paralytic. With alternations of moderate exercise, rest in the slings, and the effect of time while the natural process of absorption is taking effect upon the callus, with other elements of change that may be so operating, the horse may in due time become able to once more earn his subsistence and serve his master.

Fracture of the Scapula.—This bone is seldom fractured, its comparative exemption being due to its free mobility and the protection it receives from the superimposed soft tissues. Only direct and powerful causes are sufficient to effect the injury, and when it occurs the large rather than the smaller animals are the

FIG. 265.—Transverse Fracture of the Scapula.

subjects. The causes are heavy blows or kicks, and violent collisions with unyielding objects. Those which are occasioned by falls are generally at the neck of the bone, and of the transverse and comminuted varieties.

The diagnosis is not always easy. The symptoms are inability to rest the leg on the ground and to carry weights, and they are present in various degrees from slight to severe. The leg rests upon the toe and seems shortened, locomotion is performed by jumps. Moving the leg while examining it and raising the foot for inspection seem to produce much pain and cause the animal to rear. Crepitation is readily felt with the hand upon the shoulder when the leg is moved. If the fracture occurs in the upper part of the bone, overlapping of the fragments and displacement will be considerable.

The fracture of this bone is usually classed among the more serious accidents, though cases may occur which are followed by recovery without very serious ultimate results, especially when the seat of the injury is at some of the upper angles of the bone, or about the acromion crest. But if the neck and the joint are

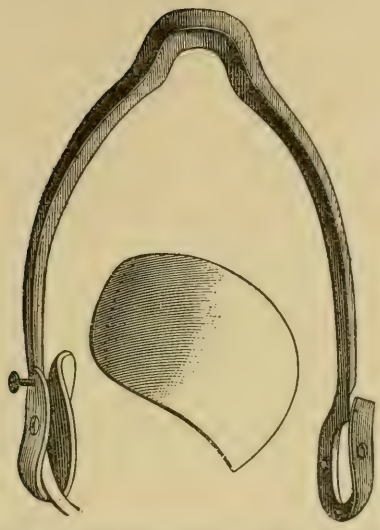


FIG. 266.—Bourgelat Apparatus for Fracture and Dislocation of the Shoulder Joint.

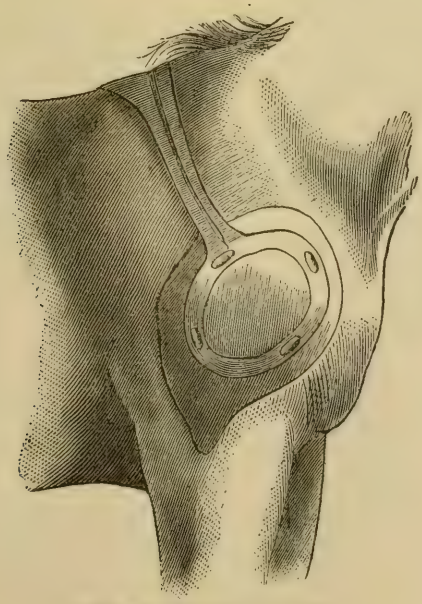


FIG. 267.—The same in place.

the parts involved, complications are apt to be present which are likely to disable the animal for life.

If there is no displacement a simple adhesive dressing, to strengthen and immobilize the parts, will be sufficient. A coat of black pitch dissolved with wax and Venice turpentine, kept in place over the region with oakum or linen bands, will be all the treatment required, especially if the animal is kept quiet in the slings.

Displacement cannot be remedied, and reduction is next to impossible. Sometimes an iron plate is applied over the parts and retained by bandages, as in the dressing of Bourgelat (Figs. 266, 267); and this may be advantageously replaced by a pad of thick leather. In smaller animals, and also in larger ones, the parts are retained by figure-8 bandages, embracing both the normal and the diseased shoulders, crossing each other in the axilla and covered with a coating of adhesive mixture.

FIG. 268.—Delwart's Bandage for Fracture of the Scapula.

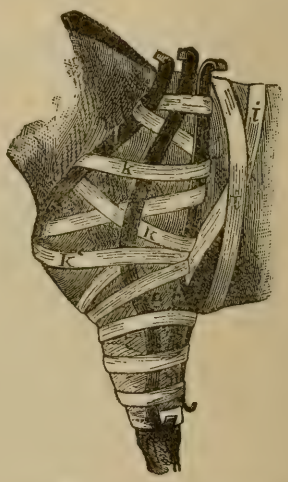


FIG. 269.—Another Bandage, with Iron Splints.

Fractures of the Humerus.—These are more common in small than in large animals, and are always the result of external traumatism. They are generally very oblique, are often comminuted, and though more usually involving the shaft of the bone will in some cases extend to the upper end and into the articular head. There is ordinarily considerable displacement in consequence of

the overlapping of the broken ends of the bone, and this, of course, causes more or less shortening of the limb. There will also be swelling, with difficulty of locomotion, and crepitation will be easy of detection. This fracture is always a serious damage to the patient, leaving him with a permanently shortened limb and a remediless, lifelong lameness.

If treatment is determined upon, it will consist in the reduction of the fracture by means of extension and counter extension, and in order to accomplish this the animal must be thrown. If successful in the reduction, then follows the application and adjust-

FIG. 270.—Comminutd Fracture of theHumerus.

FIG. 271.—Oblique Fracture of the Humerus with Displacement and Partial Union.

ment of the apparatus of retention, which must needs be of the most perfect and efficient kind. And finally, this, however skillfully contrived and carefully adapted, will often fail to effect any good purpose whatever.

Fracture of the Forearm.—A fracture in this region may also involve the radius or the cubitus, the first being broken at times in its upper portion above the radio-cubital arch at the olecranon. If the fracture occurs at any part of the forearm from the radio-

cubital arch down to the knee, it may involve either the radius alone or the radius and the cubitus, which there intimately unite.

Besides having the same etiology with most of the fractures, those of the forearm are, nevertheless, more commonly due to kicks from other animals, especially when crowded together in large numbers in insufficient space. It is a matter of observation that, under these circumstances, fractures of the incomplete kind

FIG. 271*a*.—Consolidated Fracof the Body of the Humerus.

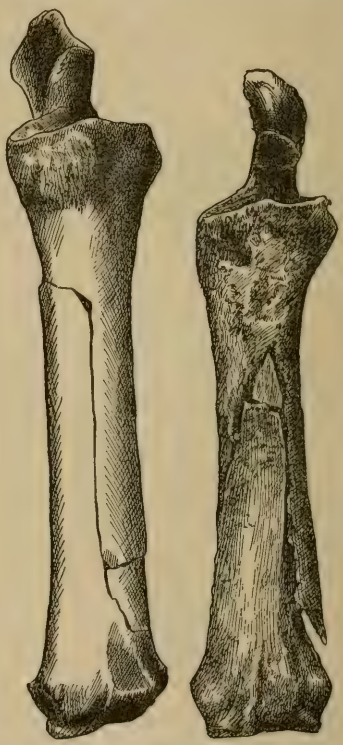


FIG. 272.
Fractures of the Radius.

are those which occur on the inside of the leg, the bone being in that region almost entirely subcutaneous, while those of the complete class are either oblique or transverse. The least common are the longitudinal, in the long axis of the bone.

This variety of fracture is easily recognized by the appearance of the leg and the different changes it undergoes. There is inability to use the limb; impossibility of locomotion; mobility

FIG. 273.—Practure of the Ulna.

below the injury; the ready detection of crepitation—in a word, the assemblage of all the signs and symptoms which have been already considered as associated with the history of broken bones.

The fracture of the cubitus alone, principally above the radio-cubital arch, may be ascertained by the aggravated lameness, the excessive soreness on pressure, and perhaps a certain increase of motion, with a very slight crepitation if tested for in the usual way. Displacement is not likely to take place except when it is well up towards the olecranon or its tuberosity, the upper segment of the bone being in that case likely to be drawn upward. For a simple fracture of this region there exists a fair chance of recovery, but in a case of the compound and comminuted class there is less ground for a favorable prognosis, especially if the elbow joint has suffered injury. A fracture of the cubitus alone is not of serious importance, except when the same conditions prevail. A fracture of the olecranon is less amenable to treatment, and promises little better than a ligamentous union.

Considering all the various conditions involving the nature and extent of these lesions, the position and direction of the bones of the forearm are such as to render the chances for recovery from fracture as among the best. The reduction, by extension and

counter-extension; the maintenance of the coaptation of the segments; the adaptation of the dressing by splints, oakum, and agglutinative mixtures; in a word, all the details of treatment may be here fulfilled with a degree of facility and precision not attainable in any other part of the organism. An important if not an essential point, however, must be emphasized in regard to the splints. Whether these are of metal, wood, or other material, they should reach from the elbow joint to the ground, and should be placed on the posterior face and on both sides of the leg. This is then to be so confined in a properly constructed box as to preclude all possibility of motion, while yet it must sustain a certain portion of the weight of the body. The iron splint recommended by Bourgelat is designed for fractures of the forearm, of the knee, and of the cannon bone, and will prove to be an appliance of great value. For small animals our preference is for an external covering of gutta percha, embracing the entire leg. A sheet of this substance of suitable thickness, according to the size of the animal, softened in lukewarm water, is, when sufficiently pliable, molded on the outside of the leg, and when suddenly hardened by the application of cold water forms a complete casing sufficiently rigid to resist all motion. Patients treated in this manner have been able to use the limb freely, without pain, immediately after the application of the dressing. The removal of the splint is easily effected by cutting it away, either wholly or in sections, after softening it by immersing the leg in a warm bath.

FIG. 274.—Bourgelat's Iron Splint for Fracture and Lugation of the Forearm.

Fracture of the Knee.—This accident, happily, is of rare occurrence, but when it takes place is of a severe character, being of the comminuted kind, and always accompanied by synovitis, with disease of the joint, requiring for treatment therefor, besides the indication of perfect immobility of the joint, that of open joints, synovitis, and arthritis.

Fracture of the Femur.—The protection which this bone receives from the large mass of muscles in which it is enveloped does

not suffice to invest it with immunity in regard to fractures. It contributes its share to the list of accidents of this description, sometimes in consequence of external violence and sometimes as the result of muscular contraction; sometimes it takes place at the upper extremity of the bone; sometimes at the lower; sometimes at the head, when the condyles become implicated; but it is principally found in the body or diaphysis. The fracture may be of any of the ordinary forms, simple or compound, complete or incomplete, transverse or oblique, etc. A case of the comminuted variety is recorded in which eighty-five fragments of bone were counted and removed.

The thickness of the muscular covering sometimes renders the diagnosis difficult by interfering with the manipulation, but the crepitation test is readily available even when the swelling is considerable and which is likely to be the case as the result of the in-

FIG. 275.—Fracture of the Femur.

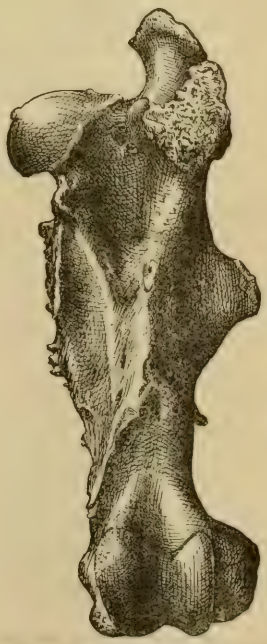


FIG. 276.—Fracture, with Shortening.

terstitial hemorrhage which naturally follows the laceration of the blood vessels of the region involved. If the fracture is at the neck of the bone the muscles of that region (the gluteal) are firmly contracted and the leg seems to be shortened in consequence. Locomotion is impossible. Crepitation may in some cases be discerned by rectal examination, with one hand resting over the coxo-femoral articulation. Fractures of the tuberosities of the upper end of the bone, the great trochanter, may be identified by the deformity, the swelling, the impossibility of rotation, and the dragging of the leg in walking. Fracture of the body is always accompanied by displacement, and as a consequence a shortening of the leg, which is carried forward. The lameness is excessive, the foot being moved, both when raising it from the ground and when setting it down, very timidly and cautiously. The manipulations for the discovery of crepitation always cause much pain. Lesions of the lower end of the bone are more difficult to diagnosticate with certainty, though the manifestation of pain while making heavy pressure upon the condyles will be so marked that only crepitation will be needed to turn a suspicion into a certainty.

The question as to treatment in fractures of this description resolves itself into the query whether any treatment can be suggested that can avail anything practically as a curative measure, whether, upon the hypothesis of reduction as an accomplished fact, any permanent or efficient device as a means of retention is within the scope of human ingenuity. If the reduction were successfully performed would it be possible to keep the parts in place by any known means at our disposal? At the best the most favorable result that could be anticipated would be a reunion of the fragments, with a considerable shortening of the bone, and a helpless, limping, crippled animal to remind us that for human achievement there is a "thus far, and no farther."

In small animals, however, attempts at treatment are justifiable, and we are convinced that in many cases of difficulty in the application of splints and bandages a patient may be placed in a condition of undisturbed quiet and left to the processes of nature for "treatment" as safely and with as good an assurance of a favorable result as if he had been subjected to the most heroic *secundum artem* doctoring known to science. As a case in point, we may mention the case of a pregnant bitch which suffered a fracture of the upper end of the femur by being run over by a light wagon.

Her "treatment" consisted in being tied up in a large box and let alone. In due time she was delivered of a family of puppies, and in three weeks she was running in the streets, limping very slightly, and nothing the worse for her accident.

Fracture of the Patella.—This, fortunately, is a rare accident and can only result from direct violence, as a kick or other blow. The lameness which follows it is accompanied with enormous tumefaction of the joint and disease of the articulation. The prognosis is unavoidably adverse, destruction being the only termination of an incurable and very painful injury.

Fractures of the Tibia are probably more frequently encountered than any others among the class of accidents we are considering. As with injuries of the forearm of a like character, they may be complete or incomplete; the former when the bone is broken in the middle or at the extremities, and transverse, oblique, or longitudinal. The incomplete kind are more common in this bone than in any other.

Complete fractures are easy to recognize, either with or without displacement. The animal is very lame, and the leg is either dragged or held up clear from the ground by flexion at the stifle, while the lower part hangs down. Carrying weight or moving backward is impossible. There is excessive mobility below the fracture and well-marked crepitation. If there is much displacement, as in an oblique fracture, there will be considerable shortening of the leg.

While incomplete fractures cannot be recognized in the tibia with any greater degree of certainty than in any other bone, there are some facts associated with them by which a diagnosis may be justified. The hypothetical history of a case may serve as an illustration:

An animal has received an injury by a blow or a kick on the inside of the bone, perhaps without showing any mark. Becoming very lame immediately afterwards, he is allowed a few days' rest. Being then taken out again, he seems to have recovered his soundness, but within a day or two, or even in a shorter time, he betrays a little soreness, and this increasing he becomes very lame again, to be furloughed once more, with the result of a temporary improvement, and again a return to labor and again a relapse of the lameness; and this alternation seems to be the rule. The leg being now carefully examined, a local periostitis is readily discov-

FIG. 277.—Fracture of the Tibia.

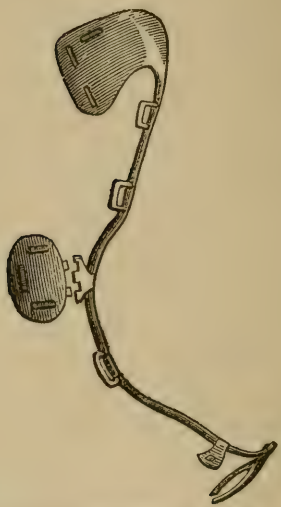


FIG. 278.—Bourgelat's Iron Splint for Fractured Tibia.

ered at the point of the injury, the part being warm, swollen, and painful. What further proof is necessary? Is it not evident that a fracture has occurred, first superficial—a mere split in the bony structure which, fortunately, has been discovered before some extra exertion or a casual misstep had developed it into one of the complete kind, possibly with complications? What other inference can such a series of symptoms thus repeated establish?

The prognosis of fracture of the tibia must, as a rule, be unfavorable. The difficulty of obtaining a union without shortening and consequently without lameness, is proof of the futility of ordinary attempts at treatment. But though this may be true in respect to fractures of the complete kind, it is not necessarily so with the incomplete variety, and with this class the simple treatment of the slings is all that is necessary to secure consolidation. A few weeks of this confinement will be sufficient.

With dogs and other small animals, there are cases which may be successfully treated. If the necessary dressings can be successfully applied and retained, a recovery will follow.

Fractures of the Hock.—Injuries of the astragalus have been recorded which had a fatal termination. Fractures of the os calcis have also been observed, but never with a favorable prognosis, and attempts to induce recovery have, as might have been anticipated, proved futile.

Fractures of the Cannon Bones.—Whether these occur in the fore or hind legs they appear either in the body or near their extremities. If in the body, as a rule the three metacarpal or metatarsal are also affected, and the fracture is generally transverse and oblique, and often compound, one of the segments protruding sharply through the skin. Having only the skin for a covering the diagnosis is easy. There is no displacement, but excessive mo-

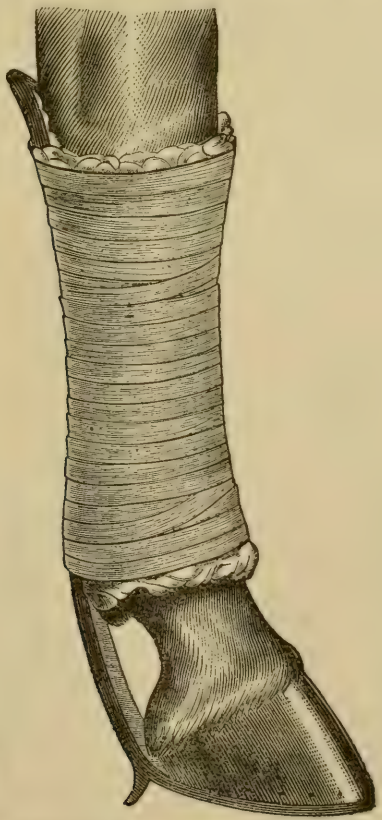


FIG. 279.—Splint and Dressing for Fractured Cannon Bone.

bility, crepitation, inability to sustain weight, and the leg is kept off the ground by the flexion of the upper joint.

No region of the body affords better facilities for the application of treatment, and the prognosis is, on this account, usually favorable. We recall a case, however, which proved fatal, though under exceptional circumstances. The patient was a valuable stallion of highly nervous organization, with a compound fracture of one of the cannon bones, and his unconquerable resistance to treatment, excited by the intense pain of the wound, precluded all chance of recovery, and ultimately caused his death from nervous fever.

The general form of treatment for these lesions will not differ from that which has been already indicated for other fractures. Reduction, sometimes necessitating the casting of the patient; coaptation, comparatively easy by reason of the subcutaneous situation of the bone; retention, by means of splints and bandages —applied on both sides of the region, and reaching to the ground as in fractures of the forearm—these are always indicated. We have obtained excellent results by the use of a mold of thick gutta percha, composed of two sections and made to surround the entire lower part of the leg as in an inflexible case.

Fracture of the first Phalanx.—The hinder extremity is more liable than the fore to this injury. It is usually the result of a

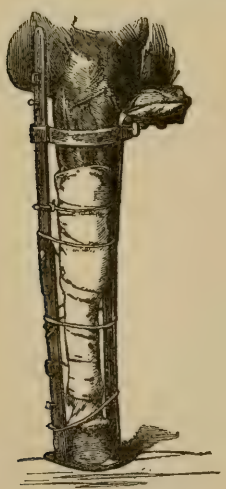


FIG. 280.—Splint and Dressing on Lower Part of Fore Leg.

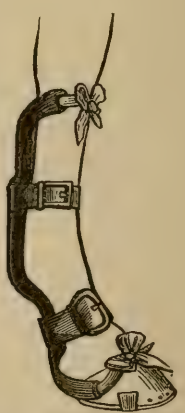


FIG. 281.—Bourgelat's Splint for Fracture of the Cannon and Phalanges.

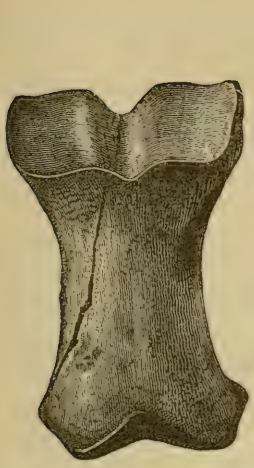
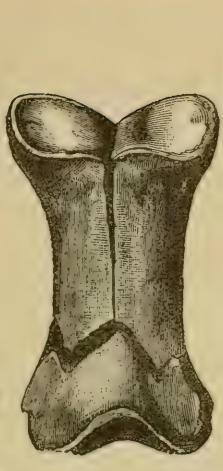


FIG. 282.
Longitudinal Fractures of the Os Suffraginis.



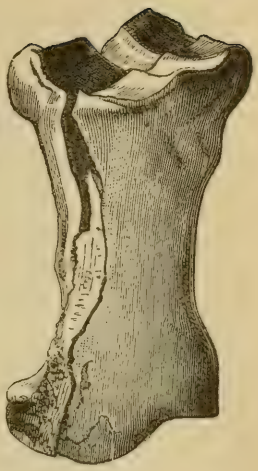


FIG. 283.
Comminuted Fracture of the Os Suffraginis.

violent effort, or of a sudden misstep or twisting of the leg, and may be transverse, or, as has usually been the case in our experience, longitudinal (Fig. 282), extending from the upper articular surface down to the centre of the bone and generally oblique and often comminuted (Fig. 283). The symptoms are the swelling and tenderness of the region, possibly crepitation; a certain abnormal mobility; an excessive degree of lameness, and in some instances a dropping back of the fetlock, with perhaps a straightened or upright condition of the pastern.

The difficulty of reduction and coaptation in this accident, and the probability of bony deposits, as of ringbones, resulting in lameness, are circumstances which tend to discourage a favorable prognosis.

The treatment is that which has been recommended for all fractures, as far as it can be applied. The iron splint of figure 281 gives excellent results in many instances, but if the fracture is incomplete and without displacement a form of treatment less energetic and severe should be attempted. One case is within our knowledge in which the owner of an injured horse lost his property by his refusal to subject the animal to treatment, the *post mortem* revealing only a simple fracture with very slight displacement.

Fractures of the Coronet.—Though these are generally of the comminuted kind, there are often conditions associated with them which justify the surgeon in attempting their treatment. Though crepitation is not always easy to detect, the excessive lameness, the soreness on pressure, the inability to carry weight, the difficulty experienced in raising the foot, all these suggest, as the solution of the question of diagnosis, the fracture of the coronet, with the accompanying realization of the fact that there is yet, by reason of the situation of the member, immobilized as it is by its structure and its surroundings, room left for a not unfavorable prognosis. Only a slight manipulation will be needed in the treatment of this lesion. To render the immobility of the

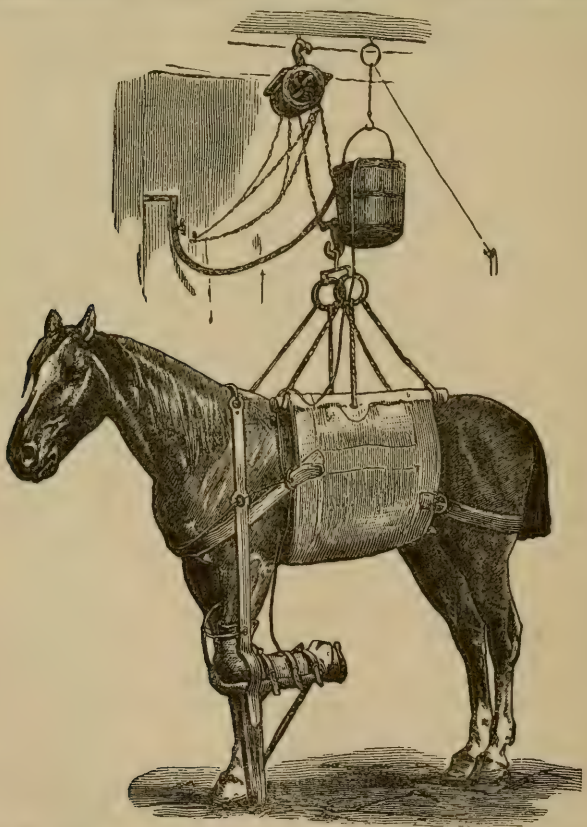


FIG. 284.—Animal with Fracture below the knee with Spints and Support, Resting in Slings.

region more fixed, to support the bones in their position by bandaging, and to establish forced immobility of the entire body with the slings is usually all that is required. Ringbone, being a common sequela of the reparative process, must receive due attention subsequently. One of the severest complications likely to be encountered is anchylosis.

Fractures of the Os pedis.—Though these lesions are not of very rare occurrence their recognition is not easy, and there is more of speculation than of certainty pertaining to their diagnosis. The animal is very lame, and, as much as possible, spares the injured foot, sometimes resting it upon the toe alone and sometimes not at all. The foot is very tender, and the exploring pincers of the examining surgeon causes much pain. There is nothing to encourage a favorable prognosis, and a not unusual termination is an anchylosis with either the navicular bone or the coronet.

No method of treatment needs to be suggested here, the hoof performing the office of retention unaided. Local treatment by baths and fomentations will do the rest. It may be months before there is any mitigation of the lameness.

Fracture of the Sesamoid Bones.—This lesion has been considered by veterinarians, erroneously, we think, one of rare occurrence. We believe it to be more frequent than has been supposed. Many observations and careful dissections have convinced us that fractures of these little bones have often been mistaken for specific lesions of the numerous ligaments that are implanted upon their superior and inferior parts, and which have been described as a "giving way" or "breaking down" of these ligaments. In our *post mortem* examinations we have always noted the fact that when the attachments of the ligaments were torn from their bony connections minute fragments of bony structure were also separated, though we have failed to detect any diseased process of the fibrous tissue composing the ligamentous substance.

From whatever cause this lesion may arise, it can hardly be considered as of a traumatic nature, no external violence having any apparent agency in producing it, and it is our belief that it is due to a peculiar degeneration or softening of the bones themselves, a theory which acquires plausibility from the consideration of the spongy consistency of the sesamoids. The disease is a peculiar one, and the suddenness with which different feet are successively attacked, at short intervals and without any obvious

cause, seems to prove the existence of some latent morbid cause which has been unsuspectedly incubating. It is not peculiar to any particular class of horses, nor to any special season of the year, having fallen under our observation in each of the four seasons. The general fact is reported in the history of a majority of cases that it makes its appearance without premonition in animals which, after enjoying a considerable period of rest, are first exercised or put to work, though in point of fact it may manifest itself while the horse is still idle in his stable. A hypothetical case, in illustration, will explain our theory.

An animal which has been at rest in his stable is taken out to work and it will be presently noticed that there is something un-

FIG. 285.—Fracture of Os Sesamoids.

usual in his movement. His gait is changed, and he travels with short, mincing steps, without any of his accustomed ease and freedom. This may continue until his return to the stable, and then, after being placed in his stall, he will be noticed shifting his weight from side to side and from one leg to another, continuing the movement until rupture of the bony structure takes place. But it may happen that the lameness in one or more of the extremities, anterior or posterior, suddenly increases, and it becomes evident that the rupture has taken place in consequence of a misstep or a stumble while the horse was at work. Then, upon coming to a standstill, he will be found with one or more of his

toes turned up—he is unable to place the affected foot flat on the ground. The fetlock has dropped and the leg rests upon this part, the skin of which may have remained intact or may have been more or less extensively lacerated. It seldom happens that more than one toe at a time will turn up, yet still the lesion in one will be followed by its occurrence in another. Commonly two feet of a biped, the anterior or posterior, are affected, and we recall one case in which the two fore and one of the hind legs were included at the same time. The accident, however, is quite as likely to happen while the horse is at rest in his stall, and he may be found in the morning standing on his fetlocks. One of the earliest of the cases occurring in our own experience had been under our care for several weeks for suspected disease of the fetlocks, the nature of which had not been made out, when, apparently improved by the treatment which he had undergone, the patient was taken out of the stable to be walked a short distance into the country, but had little more than started when he was called to a halt by the fracture of the sesamoids of both fore legs.

While there are no positive premonitory symptoms known of these fractures we believe that there are signs and symptoms which come but little short of being so, and the appearance of which will always justify a strong suspicion of the truth of the case. These have been indicated when referring to the soreness in standing, the short "mincing" gait, and the tenderness betrayed when pressure is made over the sesamoids on the sides of the fetlock, with others less tangible and definable.

These injuries can never be accounted less than serious, and in our judgment will never be other than fatal. If our theory of their pathology is the correct one, and the cause of the lesions is truly the softening of the sesamoidal bony structure and independent of any changes in the ligamentous fibers, the possibility of a solid osseous union can hardly be considered admissible.

In respect to the treatment to be recommended and instituted it can only be employed with any rational hope of benefit during the incubation, and with the anticipatory purpose of prevention. It must be suggested by a suspicion of the verities of the case, and applied before any rupture has taken place. To prevent this and to antagonize the causes which might precipitate the final catastrophe—the elevation of the toes—resort must be had to the slings and to the application of firm bandages or splints, perhaps

of plaster of Paris, with a high shoe, as about the only indications which science and nature are able to offer. When the fracture is an occurred event, and the toes, one or more, are turned up, any further resort to treatment will be futile.

DISLOCATIONS.

Strength and solidity are so combined in the formation of the joints of our large animals that dislocations or luxations are injuries which are but rarely encountered. They are met with but seldom in cattle and less so in horses, while dogs and smaller animals are more often the sufferers.

The accident of a luxation or (its synonym) dislocation (*displacement*) is less often encountered in the animal races than in man. This is not because the former are less subject to occasional violence involving powerful muscular contractions, or are less often exposed to casualties similar to those which result in luxations in the human skeleton, but because it requires the cooperation of conditions, anatomical, physiological, and perhaps mechanical, present in one of the races and lacking in the other, but which can not in every case be clearly defined. Perhaps the greater relative length of the bony levers in the human formation may constitute a cause of the difference.

Among the predisposing causes in animals, caries of articular surfaces, articular abscesses, excessive dropsical conditions, degenerative softening of the ligaments, and any excessive laxity of the soft structures, may be enumerated.

The symptoms of fractures and of dislocations are not always so variant as to preclude the possibility of error in determining a case without a thorough examination, but the essential difference, as it must always exist, must always be discoverable.

In a dislocation there is one very peculiar and characteristic feature in the impossibility of motion associated with an excessive liberty of movement—the impossibility of active or controlled motion, and a facility of passive movement (or movableness) at either the affected joint or at another of the same leg near to it. In a dislocation of the scapulo-humeral (or shoulder) joint the animal possesses no power of motion over the limb—no muscular contraction can avail to cause it to perform its various functions —but in the hands of the surgeon it may be made to describe a

series of movements which would be simply impossible with the joint in a state of integrity. Both fractures and luxations are marked by deformity, but while in a fracture with displacement there will usually be a shortening of the leg, a dislocation may be accompanied by either a shortening or a lengthening. Swelling of the parts is usually a well-defined feature of these injuries.

With all this similarity in the symptomatology of luxations and fractures, there is one sign which either by its presence or its absence will greatly assist in settling a case of differential diagnosis, and this is the existence or lack of *crepitation*. It has no place or cause in a mere dislocation; it belongs to a fracture, if it is a complete one. If there is crepitation with a dislocation then it proves that there is a fracture also.

The prognosis of a luxation is comparatively less serious than that of a fracture, though at times the indications of treatment may prove to be so difficult to apply that complications may arise of a very severe character.

The treatment of luxations must of course be similar to that of fractures. Reduction, naturally, will be the first indication in both cases, and the retention of the replaced parts must follow. The reduction involves the same steps of extension and counter-extension performed in the same manner, with the patient subdued by anesthetics.

The difference between the reduction of a dislocation and that of a fracture consists in the fact that in the former the object is simply to restore the bones to their true normal position, with each articular surface in exact contact with its companion surface, the apparatus necessary afterwards to keep them in situ being similar to that which is employed in fracture cases, and which will usually require to be retained for a period of from forty to fifty days, if not longer, before the ruptured retaining ligaments are sufficiently firm to be trusted to perform their office unassisted. A variety of manipulations are to be employed by the surgeon, consisting in pushing, pulling, pressing, rotating, and indeed whatever movement may be necessary, until the bones are forced into such relative positions that the muscular contraction, operating in just the right directions, pulls the opposite matched ends together in true coaptation, a head into a cavity, an articular eminence into a trochlea, as the case may be. The "setting" is accompanied by a

peculiar snapping sound, audible and significant, as well as a visible return of the surface to its normal symmetry.

Special Dislocations.—While all the articulations of the body are liable to this form of injury, there are three in the large animals which may claim a special consideration, viz:

The Shoulder Joint.—We mention this displacement without intending to imply the practicability of any ordinary attempt at treatment, which is usually unsuccessful, the animal whose mishap it has been to become a victim to it being disabled for life. The superior head of the arm bone, as it is received into the lower cavity of the shoulder blade, is so situated as to be liable to be forced out of place in four directions. It may escape from its socket, according to the manner in which the violence affects it, outward, inward, backward, or forward, and the deformity which results and the effects which follow will correspondingly differ. We have said that treatment is generally unsuccessful. It may be added that the difficulties which interpose in the way of reduction are nearly insurmountable, and that the application of means for the retention of the parts after reduction would be next to impossible. The prognosis is sufficiently grave from any point of view for the luckless animal with a dislocated shoulder.

The Hip Joint.—This joint partakes very much of the characteristics of the scapulo-humeral articulation, but is more strongly built. The head of the thigh bone is more separated, or prominent and rounder in form, and the cup-like cavity or socket into which it fits is much deeper, forming together a deep, true ball-and-socket joint, which is, moreover, re-enforced by two strong cords of funicular ligaments, which unite them together. It will be easily comprehended, from this hint of the anatomy of the region, that a luxation of the hip joint must be an accident of comparatively rare occurrence. And yet cases are recorded in which the head of the bone has been affirmed to slip out of its cavity and assume various positions, inward, outward, forward, and backward.

The indications of treatment are those of all cases of dislocation. When the reduction is accomplished the surgeon will be apprised of the fact by the peculiar snapping sound usually heard on such occasions.

Pseudo luxations of the Patella.—This is not a true dislocation. The stifle bone is so peculiarly articulated with the thigh

bone that the means of union are of sufficient strength to resist the causes which usually give rise to luxations. Yet there is sometimes discovered a peculiar pathological state in the hind legs of animals, the effect of which is closely to simulate the manifestation of many of the general symptoms of dislocations. The peculiar pathological condition originates in muscular cramps, the action of which is seen in a certain change in the coaptation of the articular surfaces of the stifle and thigh bone, resulting in the exhibition of a sudden and alarming series of symptoms which have suggested the phrase of "stifle out" as a descriptive term. The animal so affected stands quietly and firmly in his stall, or perhaps with one of his hind legs extended backward, and resists every attempt to move him backward, and if urged to move forward he will either refuse, or comply with a jump, with the toe of the disabled leg dragging on the ground and brought forward by a second effort. There is no flexion at the hock and no motion at the stifle, while the circular motion of the hip is quite free. The leg appears to be much longer than the other, owing to the straightened position of the thigh bone, which forms almost a straight line with the tibia from the hip joint down. The stifle joint is motionless, and the motions of all the joints below it are more or less interfered with. External examination of the muscles of the hip and thigh discovers a certain amount of rigidity, with perhaps some soreness, and the stifle bone may be seen projecting more or less on the outside and upper part of the joint.

This state of things may continue for some length of time and until treatment is applied, or it may spontaneously and suddenly terminate, leaving everything in its normal condition, but perhaps to return again.

Pseudo-dislocation of the patella is likely to occur under many of the conditions which cause actual dislocation, and yet it may often occur in animals which have not been exposed to the ordinary causes, but which have remained at rest in their stables. Sometimes these cases are referred to falls in a slippery stall, or perhaps slipping when endeavoring to rise; sometimes to weakness in convalescing patients; sometimes to lack of tonicity of structure and general debility; sometimes to relaxation of tissues from want of exercise or use.

The reduction of these displacements of the patella is not usually attended with difficulty. A sudden jerk or spasmodic

action will often be all that is required to spring the patella into place, when the flexion of the leg at the hock ends the trouble for the time. But this is not always sufficient, and a true reduction may still be indicated. To effect this the leg must be drawn well forward by a rope attached to the lower end, and the patella, grasped with the hand, forcibly pushed forward and inward and made to slip over the outside border of the trochlea of the femur. The bone suddenly slips into position, the excessive rigor of the leg ceases with a spasmodic jerk, and the animal may walk or trot away without suspicion of lameness. But though this may end the trouble for the time, and the restoration seem to be perfect and permanent, a repetition of the entire transaction may subsequently take place, and perhaps from the loss of some portion of tensile power which would naturally follow the original attack in the muscles involved, the lesion might become a habitual weakness.

Warm fomentations and douches with cold water will often promote permanent recovery, and liberty in a box-stall or in the field will in many cases insure constant relief. The use of a high-heeled shoe is recommended by European veterinarians. The use of stimulating liniments, with frictions, charges or even severe blisters, may be resorted to in order to prevent the repetition of the difficulty by strengthening and toning up the parts.

AMPUTATIONS.

To amputate is simply to *cut off*. In veterinary surgery it comprehends the removal from the body of an animal of one or more of its projecting parts, as a portion of a leg, or an entire extremity; the horns, the ears, the penis, the tail, etc. From the nature of the case it involves a degree of deformity, greater or less, with a loss of the function of the severed member.

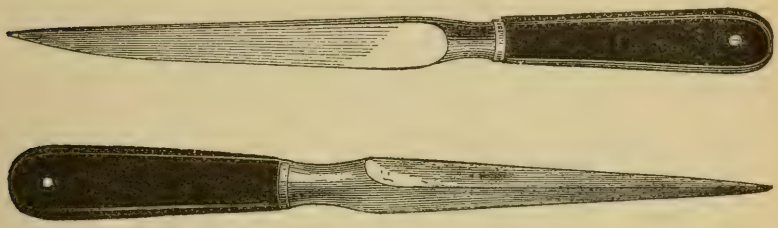
The difference between amputation and extirpation has respect only to the organs or members which become subject to the operation. The parts already referred to are amputated; the organs or members liable to extirpation have their seat in the interior regions, as the testicles, the ovaries, and even the uterus, in females, and any other non-vital organs or morbid growths, including some of the glandular structures, more particularly the lymphatic.

Amputations in domestic animals are of two classes: In one case they are performed at the dictate of a capricious fashion, for

the alleged purpose of improving the appearance of the animal, and are performed upon parts of only secondary and accessory functional importance, and which may be removed almost with impunity, as the ears, the tail or the horns.

In the second class, the subject is brought under the general laws governing diseases and remedies, and they are practiced only as it becomes necessary by the existence of diseased conditions in important organs, such as the penis, the tongue and the locomotory organs. In this class the serious nature of the operation must be measured by the importance of the function fulfilled by the organ implicated.

The instruments necessary for the operation are amputating knives, similar to those used in human surgery, or more commonly those belonging to our veterinary work, a strong, convex bistoury,



FIGS. 286, 287.—Amputating Knives.

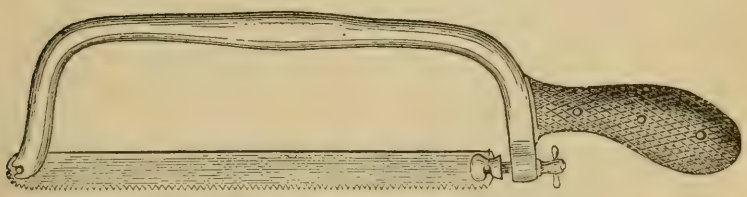


FIG. 288.—Amputating Saw.

which is generally sufficient, an amputating saw, means of temporary hemostasis, cord, an elastic band or ligature, needles, sutures and artery and dissecting forceps.

For dressings, balls and pads of oakum of various sizes, compresses and antiseptic washes are needed.

In the present chapter we shall limit our consideration to the amputation of the legs, the horns and the ears.

Amputation of Members or Limbs.

The amputation of the limbs of animals is a matter of much less importance than a similar mutilation would be in human surgery, and its occurrence is relatively much less frequent, being necessarily limited by the exclusion of that large class of subjects whose usefulness would necessarily be lost by the total impairment of their organs of locomotion, thus rendered unfit for their work, and even when it is indicated for animals designed for food consumption, the question becoming pertinent whether it would not be wiser and more profitable, in a large majority of cases, as it would unquestionably be more humane, to deliver them at once to the butcher, before subjecting them to a painful mutilation which must necessarily more or less impair their condition, and therefore materially diminish their market value.

As a matter of fact, it is principally upon dogs that, in ordinary circumstances, the veterinarian is called to operate in this manner, as even in his mutilated condition, he may continue to be able to fulfil many of his duties as one of the domestic animals. But still there are circumstances in respect to animals other than the dog, under which the operation may be indicated and rationally practiced, as when the life of a valuable animal is to be saved on account of his desirable qualities as a breeder, and which may not be disabled from his special function by the lack of a limb. A valuable ram or bull, a high-bred ewe or cow, or perhaps also a mare or a stallion, may, for such a reason, become proper subjects for an amputation.

But even under these conditions, other considerations of importance must not be overlooked, and whether it is a fore or a hind leg which must be sacrificed, will be a point of great weight to be considered in deciding for or against the operation. A female with only three legs may yet carry a fœtus to term, and be fattened and put in good condition before being sold for meat, or may possibly be covered by a male; but it would be impossible for the stallion or the bull, deprived of one of his hind quarters, to mount and keep the raised position a sufficient time to complete the act of copulation.

Animals of small size and weight, being more supple and active in their movements, suffer least from the loss of one of their limbs. The distance from the mass of the body to the seat of the ampu-

tation is also a consideration of moment. A reference to all the reasons will necessarily prove that of all domesticated animals, the horse is probably the one upon which the operation is least justifiable. If ever to be performed upon him, it can only be upon the lower regions of the leg close to the ground, inasmuch as the shortened leg can still be made useful as an apparatus of support, either directly or indirectly, by artificial means.

The sum of the matter seems to be embodied in the following general considerations pertaining to the question of the amputation of the limbs of our domestic animals:

1st. *In Dogs* it is indicated in diseases of both bones and soft parts, as in comminuted fractures, complicated with contused wounds of the skin or other soft strictures; in old caries, complicated with suppurative arthritis; in osteo-sarcoma; in the crushing of muscular tissues around bones and their complete separation; in extensive gangrene, as that resulting from the application of too tight a bandage; in chronic suppurative articular disease; in sloughs of soft tissues surrounding the exposed bones; and in deep cancerous affections.

2d. *In Ovines.*—Indications are offered, as in dogs, in comminuted fractures, with lacerations of soft tissues, and more commonly in complicated phalangeal arthritis.

3d. *In Bovines.*—The same conditions exist as in the smaller ruminants.

4th. *In Equines.*—Amputation is indicated as a means of saving an animal for breeding purposes; in complicated fractures of the cannon bone, or of the phalanges; in gangrene of the digital organs; extensive abscesses of the same region, with softening of tendons, and in suppurative arthritis. It is also sometimes performed for the removal of a supplementary limb.

5th. *In Birds.*—The amputation of a wing or even of a leg can be performed, either to prevent flight, or to relieve a diseased process of the limb.

But in all cases it should be performed upon healthy tissues, above the seat of the disease, and at the greatest, possible distance from the trunk.

The number of cases on record is not large, and they are principally reported in European veterinary journals. In these we find a case of amputation at the hock in a ewe, by Chabert; in a cow at the knee, by Chaumontel; in an ox of one of the toes, by

Durant; in a dog at the arm, by Fromage de Feugre; in a sheep, in a case of foot rot, by Lecoq; in a mare at the fetlock, by Maurette; in a stallion, on the third phalanx, by Bouley; and in English journals: in a cow in the metacarpal region, by Laing; a cow on the hind cannon, by Shield; and on a mare in this country, by Huidekoper. Others are reported, which were attended by various degrees of success, many of them, however, terminating fatally.

The proper mode of performing the operation is to secure the animal in the decubital position, and to place him under the influence of general anesthesia, securing temporary hemostasis, by the application of the circular ligature, or a bandage tightly placed above the point of amputation, or, preferably, by using the process of Esmarch, which secures a more perfect removal of the blood, and enables the operator to perform a thoroughly bloodless operation. Digital pressure, sometimes recommended for the smaller animals, will not, however, secure as good a result as that obtained by the circular ligature.

The operation is made in two ways: first, in the *continuity* of the bones, or by the division of the substance of the bone itself; and second, in their *contiguity*, or at the nearest sound articulation. This last is also called *disarticulation.*

All amputations consist of three steps: The division of the soft tissues, that of the bones, and the arrest or prevention of hemorrhage.

The First Step, the Division of the Soft Tissues, may be practiced several ways, among which the principal are the circular, elliptic and the ovalar methods, and that by flaps; all of which have the common object in view, of leaving a flap of proper form and sufficient dimensions to cover the stump of the bone, and prevent its projection beyond the surface of the wound.

The *circular* method, which is the oldest, consists in incising the skin in a circular manner, stretched over the surface of the region with the left hand of the operator, or with that of an assistant. This must be done with rapidity, made by one stroke of the knife, applied as perpendicularly over the skin as possible.

If the amputation is to be made in the continuity of the bones, the skin being divided while stretched by the assistant, is separated from its adhesions underneath, and reversed upward; when close to the line where it is yet adherent, the muscles are divided circularly, by one stroke of the knife, drawn to the bone. These

muscles spontaneously retreat, and the superior stump is drawn upward beyond the cutaneous incision. This action may be facilitated by separating from the bone whatever attachments may exist between them. The periosteum is thus divided, on a level with the retracted muscles.

The amputation in the contiguity of the bones, differs from that in the continuity only in the fact that when the section of the muscles is made, there is no division of the periosteum necessary, and the disarticulation is completed with either the bistoury or amputating knife, or, in preference, with the sage knife. The method *by flaps* consists in making on one or both sides of the bones, one or two flaps of skin which are afterwards united to cover the stump, and form the new surface.

In amputation by the contiguity of the bone, the method to be preferred, and which may be practiced both from within, outward and contrarywise, is this: In the first instance, the knife is passed through the soft tissues at the point where the bone is to be separated, and the entire mass divided by drawing the instrument toward the operator in a somewhat oblique direction. In the second way, or from without inward, the flap is first drawn with the point of the knife, and then dissected from without, or, otherwise, made at once in the same direction, by one stroke of the instrument. The flaps must be rounded, not angular, at their line of meeting, and in such a way that the amputated wound will represent an elliptic infundibulum, whose center is occupied by the stump of the bone, surrounded by whatever projecting fleshy structures may be brought over it to form a protective cushion.

The second step of the operation is that of the *section* of *the bone*, or of the *articular attachments*.

In sawing the bone in its continuity, the periosteum being divided, and the soft tissues protected by compresses, some little art is necessary. The saw applied perpendicularly to the axis of the bone, should be worked slowly at first, until a track is formed, after which the movement may be more rapid. Pressure upon the instrument is unnecessary, if it has been properly set. Special caution should be observed in finishing, in order to avoid leaving rough edges to be cut off with the bone forceps. The saw must be propelled wholly by the action of the arm of the surgeon, his body remaining completely motionless.

When the amputation is made upon the segment of a leg

which has two bones, though they may be divided separately, it will be preferable, if they can be held together with sufficient firmness, to act upon them jointly, but finishing the smaller bone first.

The actual disarticulation, or second step of the amputation, is performed by dividing the ligaments or other structures which surround the joint, from without inward. Beginning with the strongest and most external ligament by giving a movement of semi-flexion to the articulation, not necessarily cutting them in their middle, the joint is penetrated by inserting the knife between the articular surfaces. The double sage knife, according to Bouley, is the most convenient. In articulations composed of irregular surfaces, united by inter-articular ligaments, care must be taken to avoid injuring the bones, and to divide the fibrous cords only, as most of the synovial capsules must be removed, in order to avoid fistulous complications.

In some disarticulations, according to Bouley, it is necessary to use the saw to remove diarthodial projections on the surface of the amputated bone, which if left in place would prove a serious obstruction to the cicatrization of the stump

The last step of the operation is the *arrest*, or, what is better, the *prevention* of the hemorrhage. It consists simply in twisting or ligating the arterial vessels which have been divided. If the means used for the temporary hemostasis prevent the operator from discovering its source, the ligatures can be slightly relaxed until it is betrayed by the oozing of the blood. The various methods of permanent hemostasis have already been considered, and need no further description.

In the application of a dressing to the wound of amputation, the requirements are few, but they are imperative, and they are sufficient, assuring the best results by their simplicity and solidity. The soft tissues and the skin must be brought together, over the extremity of the bone, and kept together by the application of a continued suture, leaving a place of drainage for the suppuration and the sloughing of the ligatures which occlude the blood vessels, and the extremities of these must be gathered together at the most dependent part of the wound. This is completed and protected by the application of an antiseptic dressing consisting of pads of oakum, absorbent cotton, or threads of tourbe, kept in place by rollers, and supported by an outside

envelope of coarse cloth. The wound may cicatrize by first or by second intention, according to the severity of the original injury, as well as to the amount of attention bestowed upon the antiseptic applications which may have been employed.

FIG. 289.—Wooden Leg after Amputation.

Complications are not uncommon after amputations, though they do not materially differ from those which are encountered in other serious operations. Among those which may be mentioned are: 1st. *Secondary hemorrhage*, as the result of carelessness in the application of the ligatures, which can be overcome, however, by immediate or lateral compression, or by the renewal of the ligature. 2d. *Abscesses*, of various dimensions, resulting from the presence of the ligatures into the wound, or possibly of necrosis of the bone. These collections are to be treated in the usual way, as are also *undermining of the skin* by suppurative collections, *phlebitis*, *purulent infection* and *gangrene*, all of these being conditions having the same indications as in other forms of traumatic lesions.

There are, however, some complications which belong specially to the sequelæ of this operation, such as may result from an improper section of the bone, which might end in the formation of a *conical* stump, a condition which, like that of *strangulation* of the stump, can only be relieved by a new amputation, with a bet-

ter section of the bone, and more careful attention to the subsequent dressing. *Necrosis* of the amputated bone may also complicate the process of cicatrization, accompanied by more or less pain and diffused suppuration, which cannot be relieved until the necrotic bone has sloughed away.

Amputations in the contiguity of the bones are, besides, likely to be complicated with *synovial fistulas*, which may be of an articular or tendinous nature. The ordinary forms of treatment in similar cases will be sufficient for these.

These general rules regulate amputations of every kind, though the various steps of the operation may have somewhat varied, according to circumstances. But whether it be in the continuity or contiguity of a bone, or whatever may be the bone involved; whether the scapulo-humeral joint, the fetlock or the digital region; or even to remove supplementary digits; they are of equal applicability, and the general *modus operandi* remains the same. Even in the operation of *amputation of the wings* we find but little room for modification or change.

In operating upon the wings of birds, with the principal object of destroying their power of flight, it may frequently be accomplished by simply cutting off the extremity of the wing, at the carpal articulation, with the scissors, and cauterizing the wound with perchloride of iron or nitrate of silver.

Another method is to pull out the feathers from the inner side of the wing, as far as the elbow joint, the skin being then incised with a bistoury somewhat below the joint, and dissected and reversed upward, the bones being then divided with the bone forceps. The wound should be carefully washed or sponged with cold water, to check the bleeding, and the skin drawn over the stump, secured by interrupted sutures. The bird requires no special attention, and the wound heals in a few days.

Amputation of Horns.

The amputation of horns is an operation the description of which dates back to 1790. It is indicated in cases of fractures, or of vicious growths which might embarrass the motions and prevent the usefulness of the animal, and also to provide against the mutual injuries which cattle are liable to inflict upon one another. It is also indicated in cases of suppurative collections in the sinuses, and for the removal of parasites from those cavities. It has

of late not only assumed a place among the operations of fashion, but has found favor from its alleged tendency to improve the quantity and quality of milk, and of the flesh yielded by animals subjected to it. It is in relation to this hypothesis that Gourdon considers it as "a great progress in the raising of horned cattle, and which, on account of the benefits that may be derived from it, is perfectly justifiable." The operation is comparatively a simple one, but nevertheless involves special considerations, varying according to the species of the animal.

1st. *In Bovines.*—If only the free extremity of the organ is to be cut off, it is done with the saw carried rapidly through the horny structure, the animal, of course, being properly secured. But occasionally, especially in cases of fracture, the section is to be made near the base, or the middle of the horn, and soft and sensitive tissues are also involved. The amputation must then be made below the fracture with a sharp saw, applied perpendicularly to the long axis of the horn, and completed as rapidly as possible.

The operation will be accompanied by some hemorrhage, but not sufficient, usually, to require the application of severe hemostatics. The wound is dressed with pads of absorbent cotton, or of carbolized or antiseptic oakum, retained by compresses or the Maltese cross bandage. Possible collections of pus must be watched for, and the sinuses should be carefully cleaned by injections.

The dressings are renewed as often as the indications require, and continued until the granulations have closed the cavities of the sinuses, and the suppuration has almost entirely subsided. The application of a permanent dressing in the form of a pitch plaster is recommended by Gourdon. It need not be removed, like the ordinary dressing, and under some circumstances is of great advantage.

Among the probable accidents attendant upon this operation, there are four which require mention:

(a) *Hemorrhages*, more or less serious, always occur after the section of the horn, and of its bony support. Usually, it is sufficiently arrested by the dressing alone, but there are times when the application of the actual cautery becomes necessary to subdue it.

(b) *Inflammation of the mucous membrane* of the sinuses may also follow. In its ordinary manifestation it is not serious, and is

likely to terminate either by resolution or even suppuration, though in a few cases it may be followed by gangrene.

(c) *Gangrene*, which generally manifests itself toward the eighth or tenth day, ordinarily ends in death, and is often accompanied by an attack of ophthalmia more or less violent.

(d) *Incomplete cicatrization* of the stump, occurring principally in cases in which the wound has been neglected, and suffered to remain too long unprotected by a dressing, and when the mucous membrane of the horn has become the seat of chronic inflammation. A central fistula usually results, accompanied by an abundant suppuration, which is apt to prove exceedingly intractable to treatment.

2d. *In many young ruminants* this operation is performed on calves two or three months old, and consists in removing the rudimentary horns. For this Charlier has invented a peculiar trephine kind of circular gouge, which is used as follows: The ani-

FIG. 290.—Charlier's Method of Amputation of Horns in a Calf. 1st Step.

mal being thrown and held by two assistants, the hair is cut short around the base of the horns, and the trephine applied over the horns in such a manner as to divide the skin and subjacent tissues down to the frontal bone where they are isolated by a circular incision. Then by a downward and horizontal twist of the trephine the divided structures are gouged out and the secreting matrix of

FIG. 291.—Charlier's Method of Amputation of Horns in a Calf. 2d Step.

the horn removed. The hemorrhage is controlled with a compressive bandage or other hemostatic, and antiseptic dressing applied. The wound generally heals rapidly and without complications.

AMPUTATION OF THE TAIL.

For some unexplainable reason the term "docking" has been applied to this operation, which is simply the removal of some of the vertebræ composing the caudal appendix. It is one of the most peculiar among the *operations of fashion*, although, of course, under some special conditions incident to all animals, it is also sometimes performed as an operation of genuine beneficent surgery. This may be the case, for example, when the tail is abnormally so long and heavy as to interfere with the usefulness and comfort of the animal, or when it becomes the seat of disease and becomes affected with caries or necrosis, or fistulous tracts, or affections of the skin. In some instances, also, this curtailing operation does constitute a true surgico-therapeutical means of obtaining a local bleeding.

Docking, which is of English origin, is now performed all over the world, and has given rise to a great deal of controversy upon the question of its propriety. Whether it is an act of inexcusable cruelty or not, it is not at present our province to decide, but from a surgical point of view we feel that it is due to truth to say that we are satisfied that a great deal of what has been said in opposition to the operation results, from the various and, too often, bungling

and cruel methods which have characterized the details of the amputation. We believe that some of these methods may be so modified as to relieve the operation of its apparent character of cruelty. We refer now especially to the means which have been and are employed for the arrest of the hemorrhage which is likely to follow the section of the blood vessels of the region.

The tail has for its bony support a series of the caudal vertebræ—from fifteen to eighteen—varying in number and diminishing in size from the sacrum to the end of the organ, and united by a thick inter-vertebral ligament, and attached to them are the caudal muscles in pairs, three on each side, the *superiors* or *elevators*, the *inferiors* or *depressors*, and the *laterals* or *inclinators*. Beside these, there is also the *ischio-caudal* muscle, which extends from the ischiatic ligament upward and backward to terminate on the sides of the first caudal vertebræ. Between each of the lateral and inferior caudal muscles runs the *lateral caudal*, and on the median line between the inferior muscles the *median caudal artery*, all running to the end of the tail, and likely, when divided, to cause a more or less troublesome hemorrhage. All these organs are surrounded by the *caudal aponeurosis*, from the deep surface of which proceed bands which form a special sheath for each muscle, and is ultimately united by its external face to the thick skin which surrounds the region. This skin on the upper and on each lateral face of the tail is covered with long, thick, coarse hair, while the inferior face is hairless, smooth and comparatively thin.

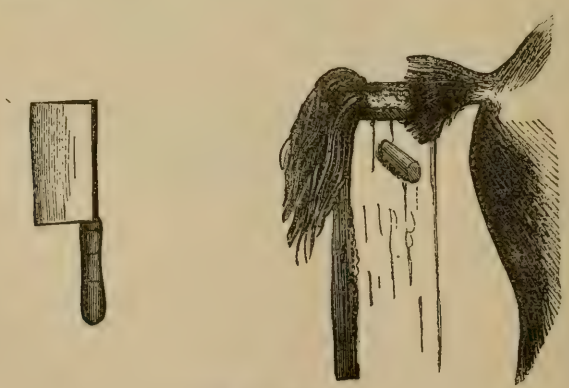


FIG. 292.—Tail Cutters.

Docking properly includes three steps: 1st, the preparation of the tail; 2d, the amputation; and 3d, the arrest of the hemorrhage. (There is, however, a mode of operation in which the last two steps can be merged into one.) The animal is kept in the upright position, and well secured.

1st *Step. Preparation of the Tail.*—This is first well washed and combed, and ought to be cleaned with an antiseptic solution. The place where the amputation is to be performed should be marked by clipping the hair from it in a circle, and above this the hair should be secured either by being braided, or simply tied tightly in a mass with a string around the tail. Some practitioners apply a cord ligature or an elastic bandage above the place to prevent the hemorrhage.

2d *Step. The Amputation.*—This is accomplished by several methods. The oldest mode was by using a simple hatchet as the instrument with which the tail, properly prepared and laid over a wooden block, was severed by a heavy blow on the "instrument." (Fig. 292).

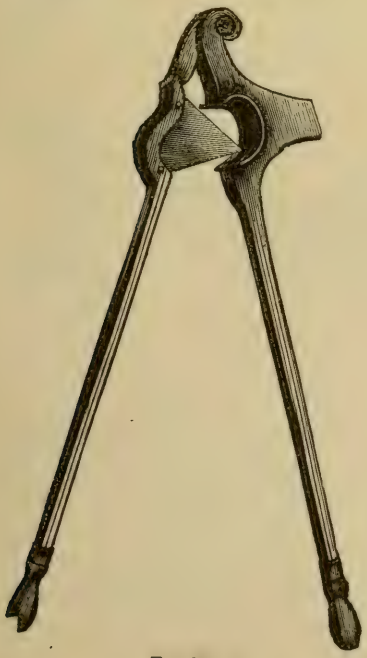


FIG. 293.

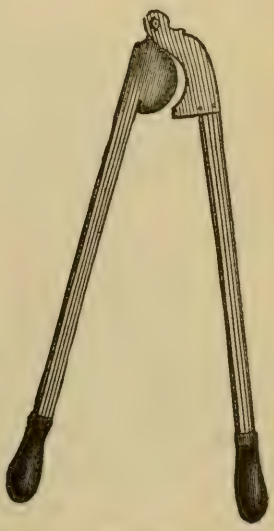


FIG. 294.

Tail Cutters.

At a later period, special knives called *tail cutters*, were introduced. These were peculiar large shears, differing more or less in general form and in that of their cutting edges, but which were used in the same manner, and are still in common use by many practitioners. The manner of using them is very simple. The tail, prepared as before mentioned, and held horizontally by an assistant, is so placed in a hollow formed in the edge of the shears as to insure a perpendicular stroke, and the division is made by closing the blades with a single quick and forcible motion. Other instruments were invented to work by springs.

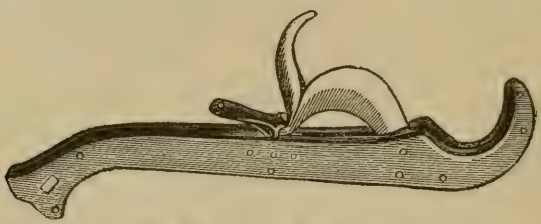


FIG. 295.—Spring Tail Cutter,

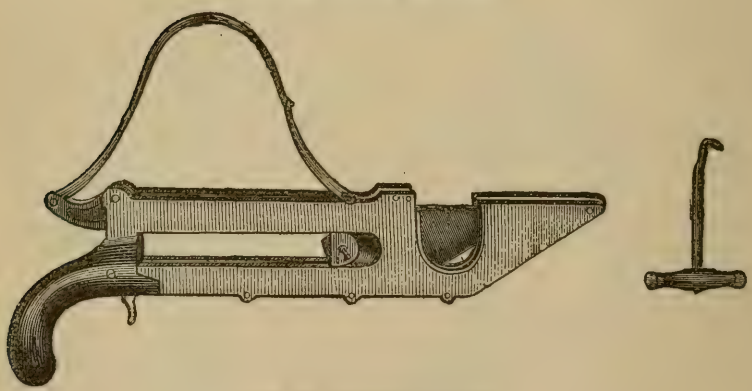


FIG. 296.—Spring Tail Cutter.

Some practitioners, instead of dividing the entire thickness of the organ, prefer to do so by disarticulating the vertebræ with a bistoury, first making flaps on each side of the skin in order to find the joint.

3d *Step.—To stop the Hemorrhage.*—The moment the tail is amputated three streams of blood spring from the stump, with more or less force, according to the position of the member, unless a ligature or an elastic bandage has been previously applied. In

either case attempts may be made to ligate or to employ torsion of the arteries, but the hemostatic generally employed is the actual cautery. The tail-cautery, heated to nearly a white heat, is firmly held upon the truncated tail for a few seconds until it has stopped the hemorrhage. To assist this process and obtain the formation of a thicker scab, certain combustible substances are sometimes placed upon the wound before the cautery is applied, to increase the heat by their ignition. A ring of hair or a little pulverized resin may be employed for this purpose.

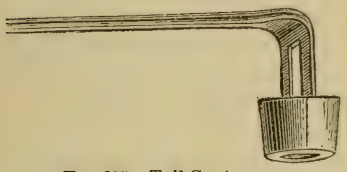


FIG. 297.—Tail Cautery.

We have before noted that in this measure of hemostasia there is much that is repulsive and coarse, and that it is not at all in harmony with the spirit of modern scientific surgery, and we have long felt a conviction that a great improvement is possible in the manipulation of such a case. We have, therefore, made the matter one of careful experimentation, and the conclusion we have reached is that the following course of procedure will meet all the indications and fulfil all the purposes contemplated, and at the same time avoid the complications likely to occur, and obviate the objections of the sensitive and the timid, besides securing results entirely satisfactory to all the parties concerned.

First, to render the operation painless, we inject cocaine at two or three points in the circumference of the tail skin. Then, around the tail, and above the ring made by clipping the hair, as before mentioned, to mark the place of amputation, we place a narrow elastic band at a tension merely sufficient to stop the hemorrhage. Having waited for the full effect of the anesthetic, and accurately identified the center of the articulation between two of the vertebræ through which we intend to amputate, with a strong and sharp bistoury we make rapidly a circular incision of the skin entirely around the tail, and, if possible, divide the muscle with a single stroke through the intervertebral ligament. With a little care and practice the amputation may be completed in a few seconds, and there remains at the end of the tail but a smooth, perfectly bloodless stump. We cover the fresh surface with a dressing powder, antiseptic, caustic or astringent as indicated, and leave the patient eating his oats as he had been doing during the operation, unaware

of the mutilation to which he has been subjected. We leave the elastic band in place for from twenty-four to thirty-six hours, possibly loosening it once during that time, or tightening it, if any oozing of blood is discovered, and removing it entirely as soon as it becomes safe to do so.

The stump generally needs no special care, except in cases of possible complications which may follow the operation. The amputation of the tail by flaps is also performed by some veterinarians with great success, this mode leaving a wound which generally heals very rapidly and without the ordinary possibility of complication.

Among these are, first, *hemorrhage.* The occurrence of this is an evidence that the hemostasia has been imperfect, probably the cauterization has not been sufficiently thorough; or the torsion of the arteries has been insufficient; or the ligature has been loosely tied. This accident requires a repetition of the manipulation, and perhaps another cauterization or torsion or ligature. With the application of our elastic band this can scarcely ever occur. If it does, another turn of the band will complete the work.

Bad aspect of the Stump.—The amputation of the tail by section through the continuity of the bone, as commonly happens when the tail-cutters have been used, leaves in the center of the wound a projecting portion of a vertebræ, which is usually burnt by the cautery, when this has been used. As the result of this, and surrounding the mortified bone, large granulations rapidly appear, overlapping the circular edges of the wound, and characterized by an abundant discharge. The necrotic bone must then be amputated and the granulations heavily cauterized with caustics of the potential kind; the saturated solution of chloride of zinc making an excellent prescription for the purpose required. To obviate this complication the operator will do well, when any portions of vertebræ have been left in the stump, to remove the fragments with the bone forceps rather than to wait for their removal by the natural process of necrosis. We have never encountered these complications when using the elastic band, being careful to amputate at the articulation of the vertabræ. The powdered dressings we have used have always kept the granulations under control.

Multiple Abscesses.—We have met these once, as the result of the presence of a very thick scab, which prevented the escape of the underlying suppuration.

Gangrene and *Tetanus* have also been recorded as sequelæ of this operation.

The rules we have given apply without change to the amputation of the tail in smaller animals, as sheep, dogs and cats.

TREPHINING.

The operation of trephining or trepanning consists in boring into or through a bony or other hard structure, in order to form an aperture for surgical purposes. Although the cranium is usually the seat of the opening, it may be made in any part of the body where the indications demand it.

The application of the *trephine* or of *terebration*, as it is called when it is performed at the base of the horns of cattle, dates back to antiquity, having a record antedating the time of Hippocrates, and yet it was not until toward the year 1749 that it in fact entered the domain of veterinary surgery. About that time Lafosse, Sr., performed it to open the frontal and maxillary sinuses in the treatment of glanders and other diseases mistaken for it. It was afterwards recommended by Greave and Haubner as the proper treatment for the relief of purulent collections in the sinuses of the head, and it has been recommended by many others for parasitic affections of the cranial cavity, as cases of cœnurus cerebralis.

Trephining is undoubtedly indicated in many pathological conditions, and in fact ought to be more frequently practiced by the veterinarian of to-day. Much has been lost, no doubt, by its neglect and disuse. Its value is most fully demonstrated in cases where it becomes necessary to remedy the effects of mechanical lesions taking the form of bloody or purulent gatherings within the cranium, like those which may result from the pressure of fragments of fractured bones upon the brain. Fractures of the cranial bones resulting in this manner are not common with our domestic animals, but when they do occur they are always of a serious nature, and too often are beyond remedy. In a case of remediable character the removal of the pressure upon the meninges by trephining and cleansing the wound from the matters which produce and continue it, whether bony fragments or bloody extravasations, is the treatment indicated before any other. Yet as experience has many times proved that the brain is able to sustain a very considerable amount of pressure without betraying

any signs of inconvenience, the indication of trephining only becomes absolute when serious nervous manifestations are exhibited. In simple contusions, or even with complete fracture of the bone, trephining is not indicated unless brain lesions are unmistakably present.

It is indicated in solipeds in cases of chronic discharges proceeding from suppurative collection in the sinuses, characterized by a yellowish, grumous, and often offensive, running at the nose, usually from but one side, and not uncommonly accompanied by a deformity of the face, caused by a bulging of the bones, and associated with it a dullness on percussion over their surface.

Jessen & Unterburger have also recommended it in cases of suppuration in the cavities of the nasal turbinated bones. In the treatment of chronic catarrhal inflammation of the horns or of the portions of the frontal sinuses which extend into the appendix of the head, in ruminants, it has given excellent results.

It is also indicated for the removal of foreign bodies, either of a pathological nature or the product of wounds, entering the cranium from the outside. It is available for the removal of polypi or any kind of neoplasm, of migrating dental cysts, of odontomæ, or as one of the first steps in the operation for the removal of diseased teeth from their alveolar cavity; in all these cases it is the first indication. It is also of common application in extracting parasites, the cœnurus especially, from the cranial cavity of small ruminants, when their location has been first positively ascertained. In some severe cases of diseased withers accompanied with abundant suppuration, which may filtrate under the internal surface of the scapulæ, and accumulate between that bone and the thorax, it has been claimed that, performed upon the scapula, it would furnish an eligible means of reaching the bottom of the collection, and providing suitable drainage and consequent relief.

Trephining the wall of the foot in special cases of laminitis, to assist the escape of the effused blood from between the laminœ has also been tried, but with what results we are not informed. It has even been performed in the treatment of immobility, but so far as we have learned, has never been followed by satisfactory results. It is also referred to in connection with the cranial inoculation of rabies, as performed by Pasteur.

The special instrument employed in the operation is the

trephine, or trepan, in various modified forms. There are also others which may be considered as accessory, viz., scissors, bistouries, forceps, bone-scrapers and elevators.

The brace and bit trephine is the original instrument which has been more or less modified, and which, while it is capable of more rapid execution, is probably less controllable than the ordin-

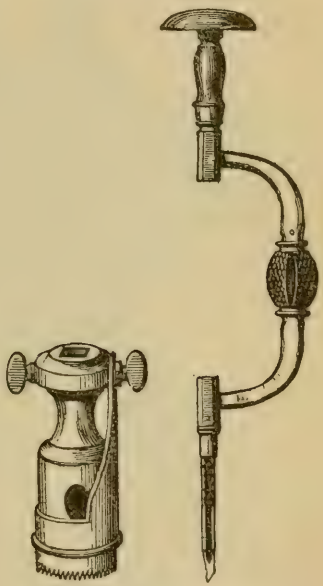


FIG. 299.—Bichat's Trephine.

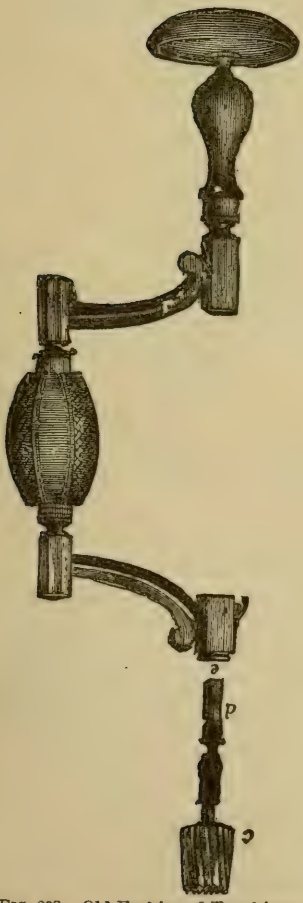


FIG. 298.—Old-Fashioned Trephine.

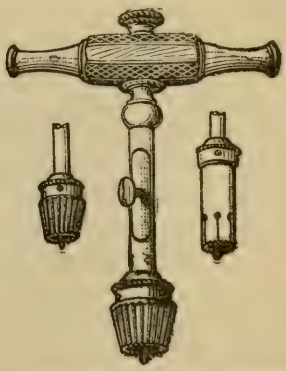


FIG. 300.—Single-Handed Trephine.

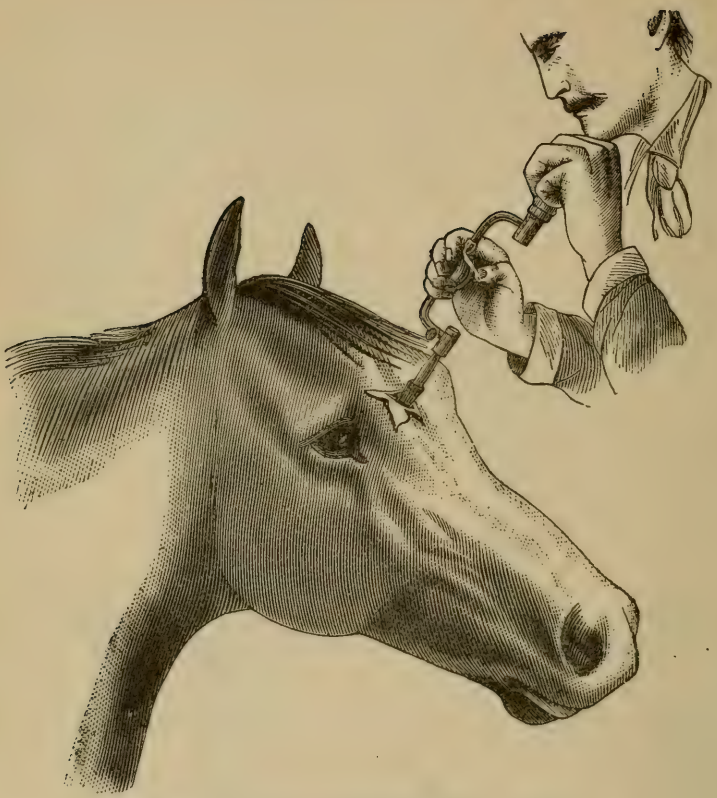


FIG. 301.—Operation of Trephining. Modus Operandi.

ary trephine (Fig. 300), and therefore not so safe. The single-handed trephine is also to be preferred from the fact that the former requires both hands to manage it, while the latter can be manipulated with a single hand. They are both what might be properly denominated true circular saws, if judged by the result of their application, which is the removal of a circular portion of the bony structure, and a corresponding round opening, through which other surgical indications can be fulfilled.

A simple *gimlet* has often taken the place of the regular instrument, but such an appliance can be considered as possessing little more than the character of a mere exploring needle, from the impossibility of making an opening with it of sufficient dimensions to be available for any other practical use.

The bone-scrapers, or elevators, which are sometimes employed as accessory, are used for preserving the periosteal covering of the bones; for removing the rough edges of the opening; or in

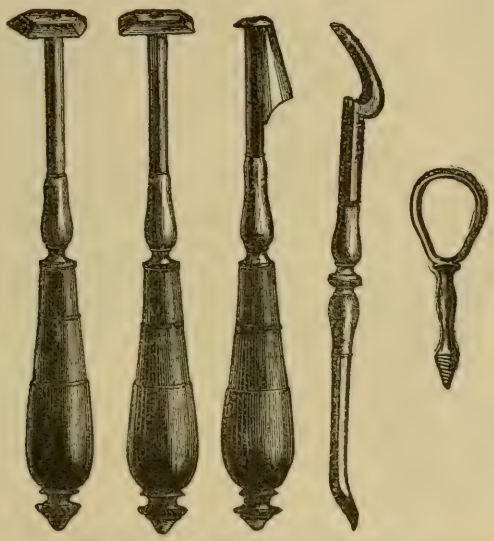


FIG. 302.—Bone Scrapers and Elevators.

raising the bony fragments which have been crushed in, or may be pressing against the cerebral substances.

An important step before entering upon the operation, is to determine the points which are to be avoided. Generally speaking, any part of the head or of the body can be operated upon, so long as there is a bony surface that can be readily exposed without danger of injuring other important organs. But, upon the head, the angles of bones and the tracts of the cranial sutures ought to be avoided. In the more common applications of the operation upon the head (Figs. 303, 304), one of four principal points is generally selected, by which to effect an entrance into the cavities of the sinuses. The points marked *b*, near the lower borders of the frontal bone, will open the frontal sinuses: the point *c*, upon the surface of the nasal bones, communicate with the superior part of the nasal cavities in the upper portion of the turbinated bone; the points *e*, upon the zygomatic bone, will enter the superior, and *f*, upon the great maxillary bone, will penetrate the lower maxillary sinus. Besides these specific regions upon which to apply the

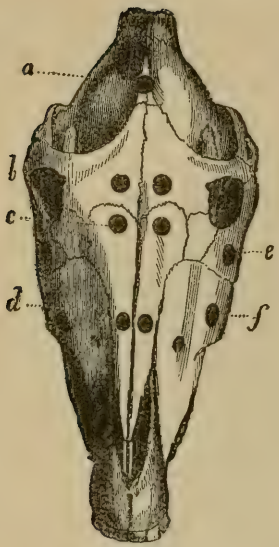


FIG. 303.

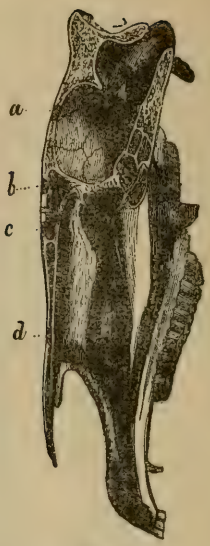


FIG. 304.

Parts of the Head where Trephining is Performed.

instrument, there are conditions where, the bone being less subcutaneous, the operation is less easily performed. Such is the case as to the lateral faces of the parietal bone, where it will be necessary to penetrate through where the crotaphite muscle is. This, however, makes a complication of little importance. Again, there are indications, such as in cases of chronic coryza, with suppuration of the sinuses, where a double trephining becomes necessary, one to enter the frontal, and the other the superior maxillary sinus. Figure 305, which is borrowed from Peuch & Toussaint, shows the exact location where the trephining can be made. A, entering into the frontal; B, the upper, and C, the lower maxillary sinuses.

The *modus operandi* of this operation is very simple. Unless the animal is very restless, and cannot be controlled by the ordinary means of restraint, or by local anesthesia, and must therefore be cast, or unless the trephining is merely the first step of an operation to remove foreign bodies or growths from the sinuses, or to apply special action upon a displaced bone, as in a fracture, we prefer to operate in the standing posture, and in such cases have found the use of cocaine of great advantage.

In any case the skin is first divided by either a V, or a T, or a

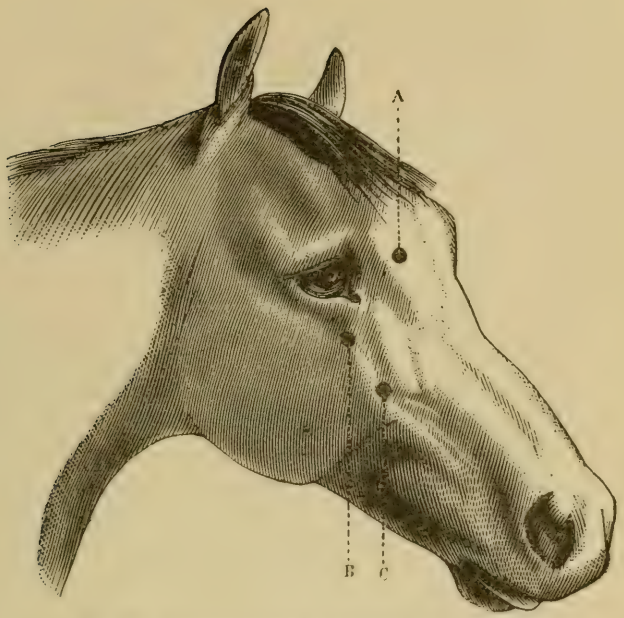


FIG. 305.—Common Points of Selection for Trephining.

semi-lunar incision. We prefer the first as being least liable to be followed by a blemish. The periosteum is divided in the same form, if its division has not already followed that of the skin. The flap thus formed in two structures is then carefully raised from the attachment to the external surface of the bone, and held aside by an assistant, with either a blunt tenaculum or forceps. The instrument is then implanted upon the centre of the exposed bony surface, and by the rotatory or semi-rotatory motion imparted to it, gradually separates a circular disk of the bone. The pressure necessary to make the instrument seize or bite on the bone may at first be considerable, but as the trephine penetrates, the force must be carefully relaxed in order to avoid the hazard of injuring the parts beneath by the sudden yielding of the bone and plunging of the instrument into the parts beneath, accompanied by the bony disk, as it separates from its last attachments, perhaps passing beyond reach, and costing no little touble and danger before it can be discovered and removed.

It is not judicious to penetrate through the bone at once. As the operator feels that he has nearly reached the last turn, the

safe plan will be to partly separate the disk with a partial, oblique turn of the trephine, and to complete the separation with the elevator. Sometimes this segment will be retained in the crown of the instrument, or, again, it will be only partially loosened. In that case, securing it with a pair of bull-dog forceps, its excision can be made complete with the bistoury, by dividing the mucous membrane of the sinus which may hold it. If the edges of the opening in the bone are not perfectly smooth, their asperities should be removed with the bone scrapers or bone knives.

The indications following the perforation of the bone vary according to the case. If it is a fracture, with pushing in of the bone, the fragments, or the bone *debris*, must be removed by being raised with the bone elevator, cutting from within outward. If a removal of a parasite of the cranial cavity is to be effected, its membranous envelopes may be carefully twisted around the jaws of the forceps, and thus removed in a single mass. In cleansing out a purulent collection in the sinus, it must be injected and washed with the proper medicated solution. If, on the contrary, the removal of a foreign body is necessary, as a polypus, or an odontoma, or the extraction of a molar tooth by gouging, it may become necessary to enlarge the opening. This is done either by chipping off the edges with the bone forceps, or by making another opening with the trephine, adjoining the first, and merging them together by properly trimming and shaping them.

The dressings required after trephining vary according to circumstances. If the trephining has been but a preliminary step to a subsequent manipulation, such as the raising of a fragment of fractured bone, or for the removal of foreign bodies, the wound, after being thoroughly and antiseptically washed, can be closed by bringing the edges of the integument together by sutures, and covering the surface with a pad of oakum, kept in place by a figure 8 roller, around the head, or by one of the frontal, single or double, already described. If, however, the operation has been performed in a locality where there would be difficulty in retaining such a dressing, the application of agglutinating preparations or plasters will effect the object.

When the frontal and maxillary sinuses have been opened, and it becomes necessary to wash out their cavities by injections thrown into them, the trephined opening must be prevented from closing by the introduction of a tent of oakum and a kind of soft cork,

which may be kept in place by securing it to the halter of the patient, to prevent it from falling into the sinus.

The cicatrization of the wound made by the trephining instrument springs from the rapid development of granualations which soon fill up the opening. These granulations soon undergo the various changes which take place in the process of calcification and ossification, and the loss of bony substance is soon completely repaired.

In a few instances, however, the seat of the operation, after a few days, assumes a most unfavorable aspect, becoming swollen and offensive, and betraying the characteristic necrotic odor. In many instances the seat of the necrosis is found to be the edge of the opening, and is due to the imperfect application of the trephine, and the destruction of the periosteum. Care must then be taken to remove all the loose necrotic fragments. To allow them to remain imbedded in the granulations and under the skin, will be to incur the certain hazard of the development of abscesses and the formation of fistulous tracts, which will refuse to heal until the last particle of diseased bone has been exfoliated and removed.

PERIOSTOTOMY.

Periostotomy is an operation which consists in the subcutaneous division of the periosteum, on the surface of bony growths. It may be for the purpose of stimulating their resolution, or it may be to relieve the pain arising from the tension of the inelastic membrane as it is pressed upon by a tumor of the bone growing under it. The operation was originally performed by Professor Sewell of the Royal Veterinary College in 1846, and was at first considered to be one of the neatest and most scientific among the methods practiced for the relief of the lameness due to exostoses. It was considered by Sewell himself to be far superior to any other means then in use, counter irritations, firing, and the rest. But although earnestly supported by the authority of its inventor, periostotomy has not sustained its claims by exhibiting all the results which were promised for it, and experience has shown that it is in many instances not only a useless, but even a dangerous operation. Several special instruments are necessary in its performance. These are a peculiar *rowel scissors* (Fig. 306) to incise the skin, for which, however, a special *bistoury* (Fig. 307) is

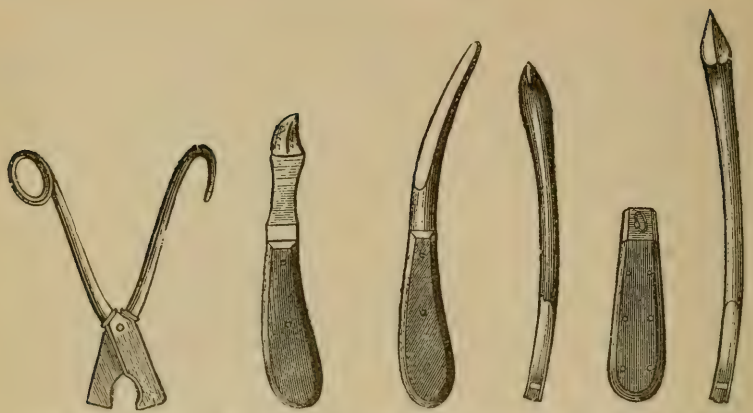


FIG. 306.—Scissors. 307.—Bistoury. 308.—Periostome. 309.—Seton Needles.

sometimes substituted; a *periostome* (Fig. 308), a kind of blunt bistoury, narrow and curved; and two flat needles (Fig. 309), short and curved flatwise, one of which is blunt, and used to divide the connective tissue, the other being sharp and to be used as a seton needle to pass a tape into the subcutaneous incision, if it is judged necessary. These needles may either be inserted into a handle, or used free.

The operation is a simple one to perform. The animal being cast and properly secured, an incision is made with the rowell scissors or the bistoury, at the most dependent parts of the bony growth, large enough to allow the introduction of the blunt curved needle. This being pushed slowly under the skin, separates it from its attachments, and upon being gradually withdrawn, the periostome is passed into the tract thus formed, directly over the bony tumor. Turning the sharp edge of the periostome on the exostosis, and pressing it over the periosteum, this is divided by subcutaneous strokes down to the most superficial layer of the exostosis, which may be incised by the instrument.

When the tumor is of long standing, a seton may be introduced by pushing into the tract, from which the periostome has been removed, the curved needle which carries the tape, and it is brought out by an opening made at the highest part of the tumor.

Sewell claims that after twenty-four hours the parts become the seat of a large swelling, and more or less inflammation may take place, but after twelve days the animal is ready to resume his work, the swelling having gradually subsided, and the lameness

passing off, sometimes the enlargement having disappeared. Our own observation, however, differs from that of Sewell and agrees with that of Reynal, as we have seen cases where excessive inflammation has followed the operation, accompanied by the persistent development of large indurated swellings, intractable to any other form of treatment, and giving rise to permanent lameness. This operation, although highly recommended by English practitioners, especially in the treatment of splints, is not, however, held in the same estimation by Continental veterinarians.

RESECTION OF BONES.

The resection of a bone is the removal of a portion of its substance, for the connection of a deviation from its normal position, or other deformity, or in cases of fracture, or necrosis, or other incurable disease. It is to a bone what excision is to the soft tissues. It has been known for a long time, but it is within only a comparatively recent period that it has found admission into veterinary surgery, and even now it is but seldon practiced. It is practicable on all parts of the skeleton, but there are some special conditions in which it is more evidently indicated than in others, such as cases of necrosis in the vertebræ, giving rise to obstinate fistulous withers, and in the treatment of some exostoses; or again in that of the complicated wounds accompanying fractures.

FIG. 310.—Various Forms of Saws.

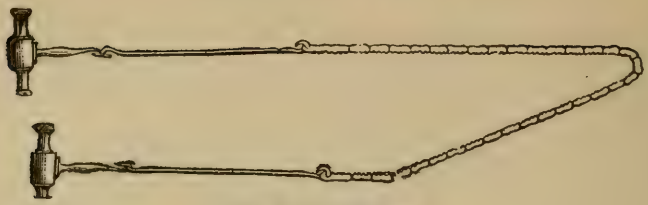


FIG. 311.—Chain Saw.

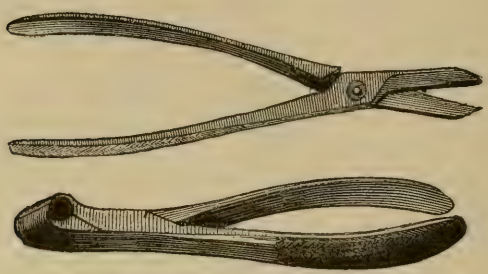


FIG. 312.—Bone Forceps.

FIG. 313.—Gouge.

FIG. 313*a*.—Chisel.

FIG. 313*b*.—Mallet.

The instruments necessary are quite numerous. Saws of different forms, including the chain saw, the bone forceps, or shears, the gouge, the chisels, and the mallets are all brought into requisition at times. Before making a resection the diseased bone must be thoroughly exposed by a free and long incision, giving ample room to the surgeon for the free use of the instruments. If the bone is already exposed, great care should be taken to protect the soft tissues, the muscles, the blood vessels and the nerves, from being accidentally wounded, by covering them with compresses, cloths, or other substances.

The manipulations will of course vary, according to the bone which is to be incised. When one of the long bones is to be resected in its long axis, either in part or in whole, the periosteum must be kept as nearly intact as possible; as the principle regenerator of the osseous tissue, its removal would necessarily interfere with the cicatrizing process. It must be very carefully separated from the bone, and isolated, to the whole extent of the segment to be removed. This done, the bone can be readily cut off, with either the chain saw or the plain instrument. The resection of bones in their articular extremities seldom occurs in our practice; it sometimes becomes necessary in diseases of the vertebræ, in fistulous withers, and occasionally in caries of the ribs.

In the first case, that of the diseased vertebræ, the excision is commonly made with the bone forceps and chisels, or even with the gouge. The principal point to observe in these instances is to avoid injury of the ligamentum nuchœ as much as possible, and to save all the periosteum that can be preserved.

The resection of ribs is accomplished with difficulty, on account of the proximity of the pleura which lines their internal surface. To avoid wounding this important organ the rib is exposed by a longitudinal or crucial incision, and after isolating the intercostal muscles from their attachments, the pleura can be pushed away from the bone with the blunt end of a scalpel, and with the chain saw introduced carefully between the bone and the pleura, the resection can be accomplished by dividing the bone from within outwards. The hemorrhage which arises from the intercostal artery can be stopped by plugging. The wound is dressed by a protective antiseptic bandage applied round the chest.

The general indications, after the resection of bones, are to carefully watch the progress of the wound and watch for the possibility of the formation of fistulous tracts, which may result from the extension of the necrosis, which may not have been entirely removed, or may result from the removal of the periosteum. These, however, may often be prevented by so regulating the process of granulation, as to prevent the accumulation of pus in the wounds, and if necessary, by applying caustics or resorting to any other of the means recommended to fulfil the existing indications.

CHAPTER VII.

OPERATIONS ON MUSCLES AND THEIR ANNEXES.

CAUDAL MYOTOMY.

This operation, more commonly known under the name of pricking, is exclusively performed on equines, and is designed to diminish the power of contraction of certain of the muscles of the tail. However it originated, it has been perpetuated by a class of horse fanciers who have, to a certain extent, made it a dictum of fashion, and by whom it has been supposed to improve the symmetry of the animals upon which it is inflicted But it has lost, in our day, much of the estimation in which it was once held, and while at first, before its prestige had been weakened, all kinds of horses, indifferently, became victims to the bad taste and thoughtless cruelty of the custom, either the external form of our horses and the mode of attachment of their tails have been improved by more skillful methods of breeding, or they have instinctively learned the regulation style of carrying their caudal extremities. Whatever may be the cause, the fact is beyond dispute that the indications for the operation have considerably diminished.

But though the effect of the division of the inferior caudal muscles is in fact, with some animals, to cause them to carry their tails in lines more graceful and more horizontal than before, it is still neccssary, in order to accomplish a successful result, that the tail should be properly attached to the body as a congenital arrangement, or well set up on the sacrum. A horse with an oblique sacrum, with the tail set low and close to the ischial tuberosities, can never be a good subject for the operation, or made to serve as a favorable example of the beautifying effect of pricking.

But with all this, there is sometimes a condition which (looking not to the welfare of the horse, but solely to the conveniences

of his master), renders caudal myotomy an operation of necessity. This occurs with those animals which have contracted the annoying habit, when driven in harness, of switching their tails over the reins and, in effect, grasping and holding them so tightly that it is only with difficulty that they can be extricated—often placing the driver in a position of imminent peril by making it impossible to control their movements at a moment when perhaps a disastrous collision or other dangerous encounter may impend.

There is also another condition which relieves caudal myotomy from the imputation of relying for its justification exclusively on the plea of being in the fashion, though it involves only the sordid argument of a money consideration. This condition is found in the case of the animal which carries its tail sidewise or with a lateral curvature—a deformity which may in many instances considerably diminish his market value. In other words, if the contra-indication of the operation is the fact of bad conformation of the animal and a low insertion of the tail, the indications, leaving aside the question of good appearance, no matter if the tail is attached low or high, are when the horse has the habit of taking hold of the reins by switching it over them, and again when the tail is carried crookedly sideways. We proceed to consider the operation under all the requirements.

Caudal Myotomy Proper, or Pricking, means the division of the two inferior sacro-caudal muscles, for the purpose of diminishing their contractile power. It is performed in several ways, most of which consist not only in the division of the muscles, but in the removal of a portion of the muscular substance. There is, however, one method of which we have failed to discover any mention by European authors, and which we have for years practiced in the United States, where it has been in vogue for a period of more than forty years. This mode of operation we shall consider in another place as the "*American method*." A glance at plate 314 will show the peculiar anatomical position of the muscles, blood vessels, and nerves of the region to be operated upon. Peuch and Toussaint refer to six modes of operations, but we think the matter can be judiciously simplified by reducing the number by at least one-half. We shall therefore adopt a simpler classification, and describe the operation as it is performed by, *first*, the transversal incision; *second*, the longitudinal; and *third*, the transversal and longitudinal in combination.

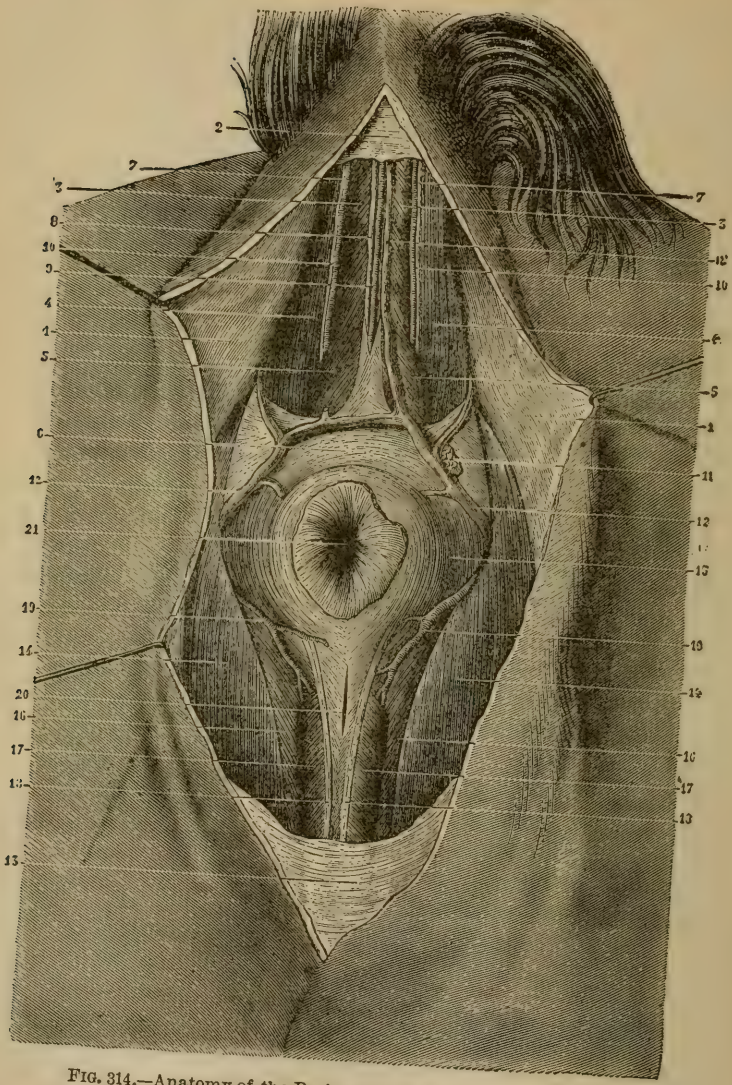


FIG. 314.—Anatomy of the Perineal, Anal and Caudal Regions.

1 1.—The skin. 2.—Portion of the aponeurotic sheath of the coccygeal muscles. 3 3.—Inferior sacro coccygeal muscles. 4 4.—Lateral sacro coccygeal muscles. 5 5.—Ischio coccygeal muscles. 6.—Suspensory ligament of the anus. 7 7.—Lateral caudal arteries. 8.—Deep caudal vein, satellite of the median artery. 9.—Median caudal artery. 10 10.—Inferior caudal nerves. 11.—Lymphatic glands. 12 12.—Superficial caudal veins. 12'.—One of the superficial caudal veins. 13.—Portion of the perineal aponeurosis. 14 14.—Semi-membranosus muscle. 15.—Sphincter ani. 16 16.—Ischio cavernous muscle. 17 17.—Bulbo cavernous muscle. 18 18.—Suspensory ligaments of the penis. 19 19.—Bulbous or internal pudic arteries. 20.—Incision of the urethral canal for urethrotomy. 21.—Anus.

The patient must be kept, as much as possible, in the standing position, with a twitch on his nose, and his hind legs hobbled, or secured with the hippo-lasso; or if he is of a very excitable and restless disposition, the stocks should be brought into requisition. The decubital position is, in our opinion, unnecessary, and undoubtedly a very inconvenient one for the surgeon, and not at all contributive to the performance of a neat operation. We have often used cocaine when pricking horses, and it has in many instances produced all the excellent effects of general anesthesia; and we prefer it, therefore, to the inhalations of chloroform which some recommend.

1st. *Operation by Transverse Incisions.*—The instruments required in this mode are a *bistouri à serpette*, an instrument resembling that known as *bistouri caché* of our obstetric cases;

FIG. 315.—Bistoury for Caudal Myotomy.

a sharp convex bistoury, and a bull-dog forceps, or a pointed tenaculum. The animal being secured in position, an assistant, placed on one side of the croup of the patient and facing the operator, raises the tail perpendicularly and well on the middle of the back of the patient, in order to render the muscles tense and cause them to project well under the fine, soft skin which covers that region. The operator, directly facing the posterior parts of the animal, then firmly grasps the tail with his left hand and steadies it, while holding the blade of the *bistouri à serpette* between the right thumb and index finger, close to its sharp part, and plunges the instrument through the skin and the entire thickness of the muscle, beginning on its inside border. or slightly on one side of the median line, and carrying

FIG. 315*a*.—How to Hold the Bistoury and Make the Incision.

the incision outward, right across the entire width of the muscle. The incision must run through the entire thickness of the organ and ought to be made by a single stroke of the instrument. The first incision is to be made about three fingers width from the base of the tail; the second from one inch and a half to two inches back of it, and the third, if not considered unnecessary, at the same distance from the second. Owing to the tapering form of the tail, the incisions should become shorter as they approach the end of that member. When all the incisions are made on the right side, the operator, if ambidexter, changes hands and reverses his mode of manipulation, proceeding otherwise in the same manner as before, being careful that all the incisions are made directly in line with one another, entirely across the muscle.

These first three incisions constitute the first step of the operation. If the division of the muscle has been made through its entire thickness, the portions of tissue between the incisions will slightly protrude, and these are to be seized with the bull-dog forceps, and drawn over to one side, while they are carefully dissected away with the convex bistoury, placed flatwise, under the muscle, with the sharp edge turned upward, and separating entirely the two portions of muscles included between the incisions. The amount of muscular tissue thus removed will measure from three to four inches in length.

FIG. 316.—Transversal Incisions in Caudal Myotomy.

The number of the incisions varies. At first one was considered sufficient, but the number was gradually increased to five, while at present common agreement has fixed the rule at three.

2. *The Operation by Longitudinal Incisions.*—This is comparatively an old mode of operating, which, having been once abandoned, was revived by Delafond, in 1833, when it was again reinstated in general practice. It requires for its performance only a strong, convex bistoury. The animal being secured in the usual position, and the tail

FIG. 316*a*.—Caudal Myotomy by Longitudinal Incisions.

kept as in the other methods, the operator makes on the middle of one of the projecting muscles a longitudinal incision, three or four inches long, dividing at one stroke the skin and the fascia underneath. From the muscle thus exposed, a portion is dissected, and by passing the bistoury under it, close to the vertebræ, it is removed by cutting it transversely at both extremities of the cutaneous incision. The removal of the muscle is made first on one, then on the other side of the median line.

3d. *Operations by Mixed Incisions.*—This was devised by Vatel, who made two transversal incisions on each side of the tail, from three to four inches apart, and uniting those of the same side by a longitudinal incision, made in the direction of each inferior caudal muscle, and then dissecting a portion of each organ with the aid of a bistoury, or a pair of scissors, securing a hold at one end with a pair of forceps, or a pointed tenaculum.

The method patronized by Brogniez, and recommended by Belgian veterinarians, requires two special instruments: the *caudal dermatome*, which is used for the division of the skin, and the *caudal myotome* for that of the muscles. The operation is minutely described by Director Degives, and includes the following steps:

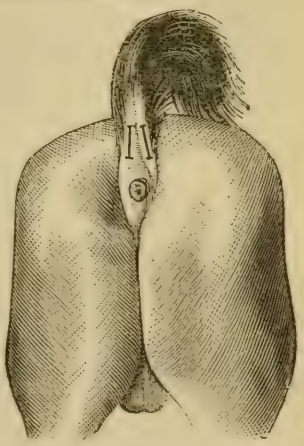


FIG. 317.—Operation by Mixed Incisions (Vatel's method)

Two or three incisions are made on the prominent part of the muscle, parallel to its long axis, the first about two fingers' width from the base of the tail, a space of about half an inch being left between each incision. These incisions are made with the dermatome, pressed perpendicularly over the tissues to be divided. The two lower incisions are first made, then the two middle ones, and the two upper ones last. By this process the skin and subcutaneous fascia are divided. The myotome is then introduced under the muscle, from within outward, and after twisting it around the organ, divides it by turning the instrument so as to bring its sharp edge against the muscular tissue. Thus divided, the muscles protrude through the incision, and are then excised in the usual way.

FIG. 318.—Caudal Dermatome.

FIG. 319.—Caudal Myotome.

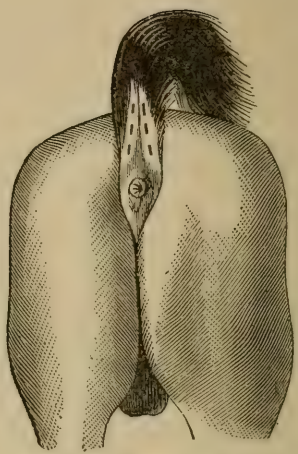


FIG. 320.—Brogniez's Mode of Operation.

The American, or Subcutaneous Method.—This requires but a single instrument, viz.: a strong, straight tenotomy knife. The operator, having the animal in the usual position, with the tail under proper control, and holding his knife flat full in the hand, plunges it flatwise through the skin, with the sharp edge turned downward, from without inward, measuring carefully to introduce it at about the separation of the lateral and inferior caudal muscles, and pushing it as nearly as possible between the mass of the muscle and the vertebræ. When the instrument has penetrated to near the median line, the sharp edge of the instrument is, by a twist of the hand, turned perpendicularly in the direction of the muscle, and by a careful sawing motion, the division of its fibers is accomplished. This is easily detected by a peculiar cracking sound, which ceases as soon as the entire thickness of the muscle is divided. The edge of the instrument can then readily be felt under the skin. The cutting must be carefully done in order to avoid the division of the entire thickness of the skin. A second and third division must follow, the number being equal on each side.

There is also another subcutaneous mode, practiced by Ger-

man veterinarians, but which is claimed by Hering to be uncertain as to its results. In this operation both a straight and a curved myotome are used. With the straight knife a small incision is made, parallel to the axis of the tail and close to the hair, and the curved myotome is then introduced between the skin and the muscle. A turn of the instrument brings its edge against the muscle, and by the usual sawing motion, the organ is divided from within outward, the blunt end of the myotome sliding upon the vertebræ.

Neither of these subcutaneous methods include the removal of any portion of muscle.

When the operation is finished, the animal may be relieved and the tail released without any apprehension of serious hemorrhage, although by reason of the unavoidable division of the lateral caudal arteries, a certain amount will necessarily take place. But this is not of a serious nature, and, as a rule, needs no special attention; we have seen the blood which had flowed quite freely while the tail was hanging pendant, cease almost immediately when the animal was returned to his stall, and the tail placed in the position to be described on another page. But in case of an unusually abundant hemorrhage, a simple compressible bandage may be applied, to be left on until the bleeding is controlled.

The treatment appropriate for wounds resulting from incision and removal of portions of muscular substance, is that which is common to all suppurating wounds, cleanliness being the most important item. While such attentions are naturally required for animals subjected to any of the various methods of operation, the subcutaneous mode can claim an important advantage in the fact that the healing process is almost always by first intention, and the tail demands no subsequent nursing.

Whatever may have been the method of operation which the animal has undergone, it will be subsequently necessary to place the tail in some given elevated position, and retain it in position for a term ranging from two to possibly four weeks, or until the wounds are cicatrized. Various devices are in use for keeping the tail in an elevated position, the simplest and probably the best of which is that *of the pulleys.* The proof is simple; either a single pulley is placed in the middle of the ceiling, or two are used, one on each side of the stall, and in either case about on a level with the loins of the animal. The tail is kept in the perpendicular

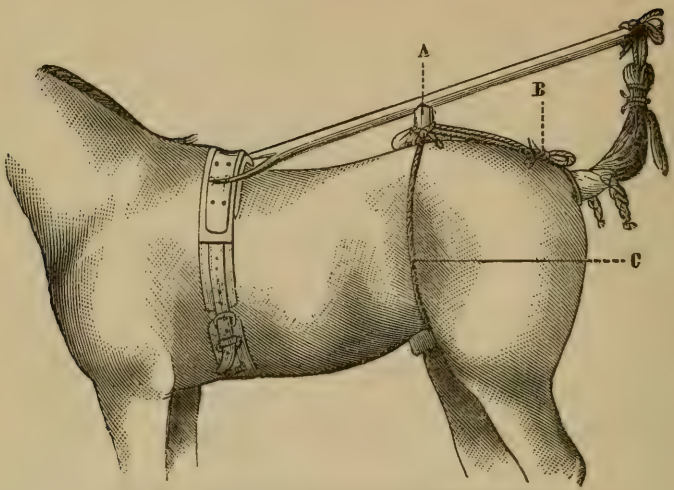


FIG. 321.—Simple Method to Keep the Tail Elevated.

position by a cord passing through the pulley, one end being secured to the tail and the other to a weight sufficiently heavy to effect the purpose (Fig. 323). A little art is necessary in attaching the cord to the tail. The hair should be nicely braided and a loop formed, and then a small wooden pin run through the braid will effectually prevent the cord from becoming detached. This plan

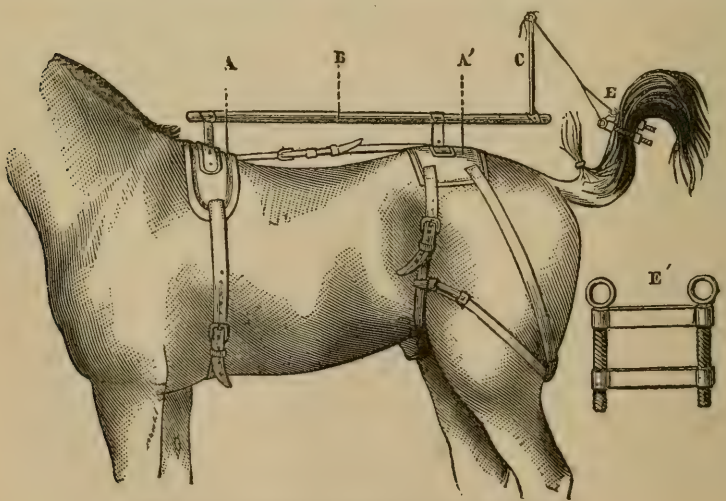


FIG. 322.—Brogniez's Apparatus to Elevate the Tail.

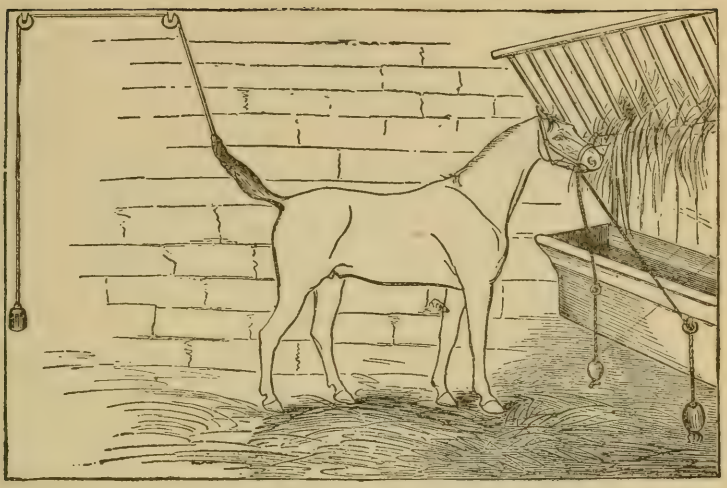


FIG. 323.—Elevating the Tail with Pulleys.

also has the advantage of equalizing the strain on the hair. In respect to the amount of weight to be employed in this process, much caution must be exercised in order to avoid excess. An error here might cause the loosening and loss of the hair, with the troublesome consequences of greatly interfering with the final result at the cost also of much suffering to the horse. The cord should run freely through the pulley and be of sufficient strength to allow the animal to lie down if disposed to do so. It will be a prudent precaution to accustom the animal to the use of the pulleys by placing them on him for a few hours daily for a short period in anticipation of the operation. It will be necessary—as we before remarked—for the horse, after that, to remain in the pulleys not less than two, and possibly three or four weeks, although after a short time he may be relieved for the purpose of taking proper exercise. The Bartlet's apparatus recommended by G. Fleming may also give very good results (Fig. 324).

Caudal myotomy is an operation, which, though simple in itself, may be followed by numerous and, at times, severe complications. Out of one hundred and forty-one animals operated upon by Hering, four died from either gangrene, severe petechial fever or suppurative infection. Among the most common accidents met with are the following:

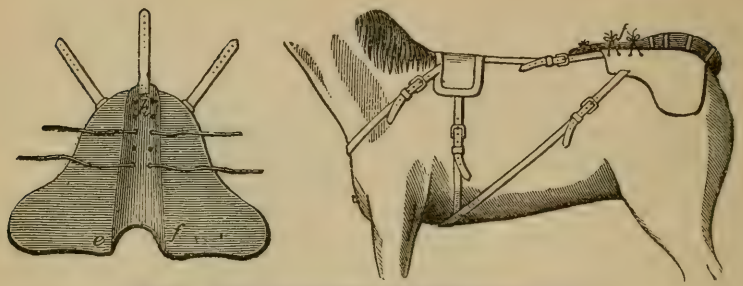


FIG. 324.—Bartlet's Apparatus, Separate and in Position.

1st. *Hemorrhage*, which is not generally serious, taking place mostly when the tail is loosened and allowed to hang down, and ceasing as soon as it is again placed in an elevated position. It is but seldom that it becomes necessary to interfere for the purpose of arresting it, which is easily effected by the ordinary means, as pressure or the application of hemostatics.

2d. *Gangrene* is one of the most dangerous sequelæ of the operation, whether resulting from excessive traction on the tail by the heavy weights, a dressing too tightly applied, or excessive inflammation, or, according to Hering, to the completed section of all the arteries supplying the tail. When becoming gangrenous, the wounds assume a brown or blackish appearance, the suppuration becomes sanious, with a repulsive, *sui generis* odor, the tail is swollen and flabby, and the œdema surrounding is cold and puffy. The gangrenous process generally begins toward the end of the tail and progresses rapidly, endangering in time the life of the patient. It is often only by the most energetic measures that it can be controlled, such as the free use of antiseptics, scarification, cauterization, or even amputation.

3d. *Wounds of the Vertebræ and of their Ligaments.*—These injuries, not so serious in their character, are usually produced by the contact of the knife during the operation, causing a scraping of the bone and wounding of the periosteum or the ligaments which unite the vertebræ. Another injury is a resulting necrosis caused by the formation of a fistula, from which a thin sanious pus is discharged, and which forms a wound which refuses to cicatrize. Though Zundel affirms that this complication is most common after the subcutaneous operation, long experience with this process fails to justify our agreement with

this assertion. When disease of the bones exists, the indication is to promote the exfoliation of the necrosed parts by free openings, antiseptic dressings, and, if necessary, caustic injections. Anchylosis of the vertebræ is a common sequel of this complication.

4th. *Abscesses.*—These suppurative collections are not uncommon, especially in animals having peculiar idiosyncrasies, as in cases of strangles. They may extend to the root of the tail, around the anus, or any part of the hind legs even to the rectal region. They require treatment similar to that of all analgous gatherings.

5th. *Anal Fistulæ.*—This accident occurs when the first incision is made so near to the anus that it enables the pus, when it forms, to filtrate between the skin and the rectum into the pelvic cavity, and is a condition which can be relieved only by giving free exit to the collected suppuration.

6th. *Tetanus.*—This termination can, in many instances, be avoided by antiseptic measures during and after the operation.

7th. *The introduction of air* into the veins is also mentioned by Loiset and Brogniez, but in our opinion there is no more reason to expect its occurrence in this than in any other operation.

8th. *Exaggerated Elevation of the Tail.*—This is one of the most common of all the sequelæ met with. In this case the tail, instead of being carried horizontally and hanging gracefully, is, on the contrary, either elevated vertically, or even laid back on the croup. This is not precisely due to improper manipulations during the operation, but is rather the result of the application of too heavy a weight and an excessive amount of traction while the animal is in pulleys. The most effectual way of avoiding this unpleasant incident is to watch closely the progress of the cicatrization by taking the patient out for exercise and watching the manner in which he carries his tail, and then increasing or diminishing the weight on the pulley, and shortening or lengthening the period of its use.

Operation for Abnormal Deviation of the Tail.—This is indicated where there is a lateral curvature of the tail, and the animal carries it sidewise, whether it be a congenital habit or occurs as one of the complications of pricking; and also when he carries it in an excessively elevated position. In these cases myotomy is performed, according to the requirements, either on

the lateral caudal muscle on the side to which the tail is carried, or upon one or both of the superior sacro-caudal muscles, the elevators of the tail. As a rule, one incision only is necessary, and it must be done subcutaneously, and in the subsequent treatment, instead of placing the animal in pulleys, the tail must be tied up to the surcingle on the side opposite to that of the operation; or it may be allowed to hang down free. An experience on our part of many years, has rendered us skeptical as to the success of lateral caudal myotomy, a careful dissection of the tails of animals affected with this deformity having proved the existence of an abnormality in the formation and development of the caudal vertebræ which has been either the cause or effect of the trouble. Operations performed upon animals of this class have not been usually followed by a satisfactory result.

CRURAL MYOTASE—CRURAL MYOTOMY.

This affection is peculiar to bovines, and is a species of dislocation, or displacement of the long vastus muscle—the *external ischio-tibial.* It is a lesion which forms a very serious impediment to the act of locomotion, by its disabling effect upon the movements of the hind leg.

The nature of crural myotase will be understood by those who are familiar with the anatomy of the region in cattle. With them, the biceps femoris covers, in its normal position, the whole of the coxo-femoral joint, in such a manner that its anterior border (*a b*), Fig. 325, is situated in front of the joint. This border, from the articulation to its lower end, forms a kind of tendon, (c) closely connected with the aponeurosis of the fascia lata, (f) whose divided layers surround the muscle, adhering intimately to its two faces, the deep and the superficial. Passing over the trochanter of the femur, with the assistance of a large mucous bursa, the biceps is quite thin, and is kept in position by an aponeurosis (c) which partially covers the gluteus externus, and is united to the fascia lata.

When this aponeurosis is lacerated at a point on a level with the hip joint, while the leg is carried backward, in excessive extension, it is possible that the trochanter, thus carried forward, may become engaged in the laceration, the biceps itself being hooked, as it were, behind the trochanter, and prevented from re-

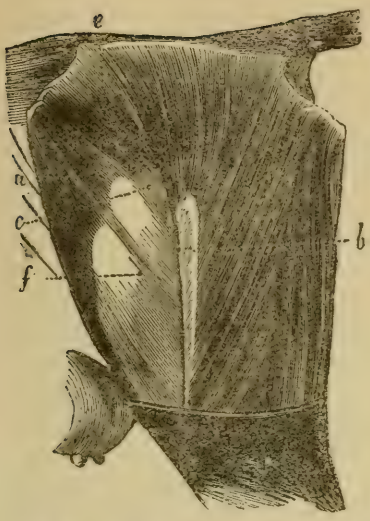


FIG. 325.—The Biceps Femoris in Cattle. Normal Position.

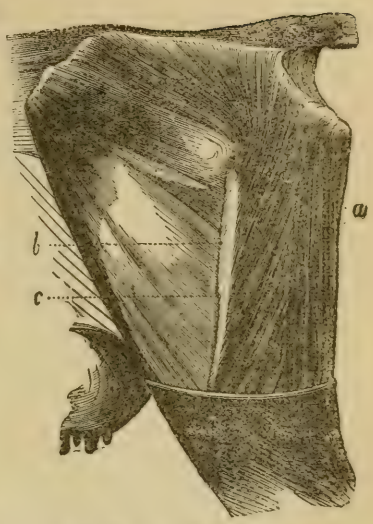


FIG. 326.—The same over the Trochanter.

turning in its normal direction. This accident has been noticed and mentioned in the remotest ages. It may result from both predisposing and occasional causes. Among the former may be reckoned the conformation of the animal, as when, for example, the croup is short, flat and narrow, the hip joint not prominent, and the trochanter high. Among the predisposing causes may also be included that of leanness, as when the animal is thin and in poor condition, and the cellular tissue deficient. The combination of these causes renders it easy for the muscle to slip over the trochanter, now relatively prominent, and it is thus that the dislocation occurs.

Occasional causes also call for mention. These include all mischances likely to bring about the excessive extension of the leg, such as falls, missteps, slipping, jumping, kicking, blows, etc., any of which may thus affect the limb and produce the lesion under consideration. And withal, it may take place without any visible, direct and efficient agency beyond the circumstance of the excessively lean condition of the animal, and even if the difficulty is remedied, and the displacement is reduced, while the same state of things continues, there is a constant liability to a return of the difficulty.

The symptoms characteristic of this lesion are readily identified. Principally, there is great difficulty in flexing the hip joint. The diseased leg is dragged on the ground, carried outward and backward and the animal resting it on the ground by the point of the hoof only. It very much resembles the position of a limb of a horse suffering with a dislocated patella. The anterior border of the muscle, hooked by the trochanter, forms a longitudinal projection, resembling a stretched cord, which becomes more and more marked when examined nearer the coxo-femoral joint. It can be made more prominent by raising the opposite leg, when it will be found extending obliquely downward from the joint to the patella. As the trochanter is no longer covered by the muscle, this bony eminence becomes directly subcutaneous, and may be readily recognized, holding posteriorly the displaced muscle, which forms a kind of tumor behind it.

These symptoms, being rarely associated with inflammatory phenomena, are not always easy to detect. There are cases where the lameness, and the carrying of the leg outward and backward, are the only apparent symptoms. The lameness, however, is characteristic, and may be temporary or intermittent, being more severe when the animal is traveling up-hill than when descending, but remaining the same on both soft or hard ground; and it sometimes happens that while the animal is in the act of descending, the muscle will suddenly return to its place with a clapping sound, and the lameness subside, though only to return again as soon as the slightest effort is required of the animal, and his hind leg is again carried backward more forcibly than usual. This peculiar intermittent character is sometimes the cause of an error of diagnosis which confounds this affection with the dislocation of the patella, but the exploration of the stifle will always serve to establish the differential diagnosis.

This accident is more or less serious in its consequences, and is particularly detrimental to the usefulness of working animals. It may sometimes, however, subside spontaneously or by simple rest, and especially if the condition of the animal is improved by good feeding with fat-producing fodder. Sometimes the displacement is complicated by a laceration of the mucous bursa with the formation of a hygroma of warm, painful, œdematous swellings, indicating the rupture of the aponeurosis or the inflammation of the cellular tissue.

Generally the dislocation is unilateral, but in other cases it may occur in both legs. This last condition is always of a serious nature, and seldom responsive to treatment. The displacement of the biceps femoris seldom recovers naturally, although where incomplete and intermittent, it may be benefitted by long rest, or when, as we have before remarked, it is due to the excessive leanness of the patient, in which case a liberal fattening diet will prove the best remedy, by removing the cause of its appearance. Local, external topical treatment by blisters, plasters, setons, etc., are of no avail. The section of the muscle or the operation of *crural myotomy*, is the indication. The *modus operandi* is not uniform, although the final object is the same in all.

Our opinion in respect to the best way of operating is in favor of that by the subcutaneous section. This is performed below the trochanter, and yet as near to it as possible, where the excessive tension of the hooked muscle can readily be felt. This consists simply in making a small incision through the skin, by which to introduce a blunt bistoury, which is inserted under the muscle, with a director or a finger for a guide, and when at a proper depth turned to bring the sharp edge towards the aponeurosis, and cutting it from within outward, carefully avoiding the section of the skin.

FIG. 327.—Gouze's Bistoury.

The bistoury invented by N. Gouze answers the purpose very well. There is no after-treatment required beyond the ordinary care required for all wounds.

Simple as the operation of crural myotomy is, some complications may accompany it.

Hemorrhage is not uncommon, usually subsiding without interference, but sometimes requiring the application of hemostatics.

Inter-Muscular Abscesses.—Diffused Suppuration.—These are the result of improper manipulations during the operation, such as lacerations of the cellular tissue by introducing the fingers too frequently into the wound, or dividing the muscle in several places.

Gangrene.—Though but rarely met with, this should be remembered among the possible contingencies. It may occur as the

result of the presence of clots of blood or other mortified tissues in the wound, and is indicated by the bad appearance of the parts, the peculiar œdematous swelling, first warm and painful, but subsequently becoming cool and painless. This condition requires prompt and efficient treatment, both external and internal.

In *Solipeds.*—We once had occasion to resort to crural myotomy for the relief of a case of pseudo-dislocation of the patella of several months' standing. The division was made towards the lower portion of the muscle, and was followed by satisfactory results, though not immediately.

OPERATIONS UPON FIBROUS TISSUES.

Tenotomy.

In the terminology of surgery, tenotomy means the *section of tendons*—an operation which contemplates the correction of deformities, from whatever cause they may proceed; the relief of pressure upon exostoses, and the prevention of the complete execution of a normal function, as that of flying in birds. Our attention will, accordingly, be directed to the study of the five varieties of *plantar*, *carpal*, *antibrachial* and *tarsal* tenotomy, with that of the *wings of birds.*

Plantar Tenotomy.

This operation is the proper remedy for the deformity known as *knuckling*, or the malposition which arises from the exaggerated flexion of the fetlock joint, and consists in the subcutaneous section of the tendons of the flexor of the phalanges.

In this affection of knuckling, which is mostly peculiar to solipeds, there is lameness more or less marked, with a hard and painful enlargement of the tendons, and a consequent interference with the act of locomotion, caused by an incomplete flexion of the articulations. The fetlock is carried forward, and contact with the ground is effected with the toe alone.

Instances of spontaneous cure or abatement are exceedingly rare. On the contrary, it has a tendency to aggravation, the swelling increasing, and the deformity becoming by degrees more and more developed, until at length the anterior face of the wall of the foot rests on the ground, and the case assumes all the well estab-

lished characters of a recognized club-foot. In a majority of cases the disease is localized in the tendon of the deep flexor of the phalanges, but it often extends to the superficial tendon as well, or may involve the tarsal or carpal band, or the suspensory ligament.

This deformity of knuckling may exist in three different degrees: either the cannon bone and the phalanges meet in an almost vertical line, as in the case of the animal *straight* or *upright on his pasterns*, which is the first degree; or the bones meet to form an angle opening backward, the phalanges being somewhat oblique in that direction, instead of forward, as in the normal state, and the animal still resting on the entire plantar surface of the foot, which is the second degree; while in the third degree these conditions are still more *exaggerated*, the animal traveling altogether on his toe and exhibiting a case of the perfect talipes. This last conformation, which exists principally in the hind legs, is specially due to the retraction of the deep flexor, while in the other degrees it is the superficial flexor which is diseased. Lesion of the suspensory ligament may coexist in either case.

The condition of the tendons, from which this deformity arises, is not the only question to take into consideration when the propriety of the operation is to be determined. The causes which have produced it must not be overlooked. For example, while in the hind legs the accident has usually a traumatic cause, such as a sprain, violent over-exertion, lacerations, or contusion of tendons; when the fore legs are affected it is most commonly as the accompaniment of some lesion in other parts of the leg, as of the foot or the digital region proper, such as bad feet, navicular disease, contraction of the heels, corns, quarter and toe-cracks, quittors, deep punctured wounds, and very commonly ringbones, or other exostoses.

Taking all these various causes into consideration, with their specific natures, and the extent of the lesions which accompany them, we are justified in believing with Gourdon, that plantar tenotomy is indicated with fair chance of success, when the knuckling results from traumatism, and the perforans tendon is alone diseased; and even when both tendons are affected, good results are still not improbable; but that it is contra-indicated whenever complications exist which are likely to prevent the leg from returning to its natural position, as when the disease is of long standing; when there are alterations of the articular surfaces;

anchylosis of the fetlock; exostoses; adhesions between the tendons and the bones; large engorgements of the tendinous structure; or chronic dilatation of the synovial bursæ surrounding the region of the fetlock. Remediable cases would seem, from this, to constitute rather a small minority of the whole number.

The fibrous tissues acted upon in plantar tenotomy, are the tendons of the flexors of the phalanges, in that part of their length which is situated back of the cannon bone, between the carpal or tarsal sheath and the fetlock. The superficial tendon reaching the fetlock forms a ring through which the deep flexor passes, a circumstance from which has been devised the manner of *perforatus and perforans*, by which they are known.

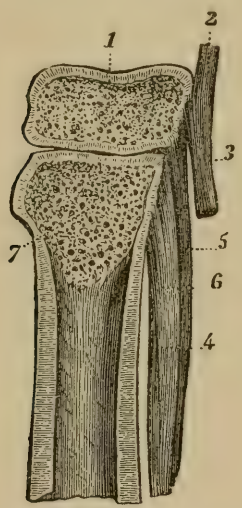


FIG. 328.—Median section at the inferior row of the carpus—of the metacarpus and suspensory ligament.

1. Os magnum.
2. Posterior common ligament of the carpus.
3. Band to the perforans.
4. Suspensory ligament.
5. Its superficial layer.
6. The deep.
7. Principal metacarpal bone.

The superficial tendon is covered by the fibrous expansion of the two carpal and metacarpo-phalangeal sheaths in the fore, and by the tarsal and metatarso-phalangeal in the hind leg. The deep flexor toward the middle of the cannon receives a strong, fibrous band coming from the posterior ligament of the carpus or tarsus. Below and between the two small metacarpal or metatarsal bones is the suspensory ligament, a strong band, thin superiorly at its origin, and bifid inferiorly. Between the suspensory ligament and the cannon bone, there is an interosseous vein and the two interosseous arteries; on the side of the tendons, the internal and external collateral veins, with, in the fore leg, the principal artery

collateral of the cannon, and the internal plantar nerve as its satellite on the inside, and the external plantar nerve on the outside of the leg; while on the posterior leg the *principal artery* of the cannon, which is the *collateral metatarsal*, is situated on the outside of the bone, and comes in relation with the tendons only in the lower part of the metatarsus.

In the anterior legs, the carpal bursa, lined with its synovial sac, extends downward on the flexor tendons as far as below the superior third of the metacarpal region; the synovial vaginal sac of the sesamoid sheath runs upward along the tendons, as far as the lower extremities of the small metacarpal bones. It is at about the center of the middle third of the cannon that the operation can be performed without fear of injuring either of these synovial sacs.

In the hind legs the tarsal sheath extends as far as the upper part of the middle third of the metatarsal region, and the sesamoid sac being the same as in the anterior leg, a little larger space is left for the operation.

Modus Operandi.—To perform plantar tenotomy, the animal must be thrown. Some practitioners operate with the horse on his feet, but this position is dangerous, although by the use of cocaine, much of the risk attending it may be obviated. The animal is thrown on either side, according to the leg upon which the operation is to be performed. If on the fore leg, it must be on the side of the leg to be operated on in order to expose the inside of the limb; if on the hind leg, the animal should be thrown in such a manner as to make the leg upon which the operation is to take place the upper one. The arrangement, according to Gourdon, makes the operation feasible both on the inside of the fore, and the outside of the hind leg.

Several modes of proceeding have been practiced. The *old method* is by a *large lateral incision*, in which the tendon is exposed, divided either with a bistoury, or by being raised from the wound and then divided. But this style of procedure necessitates the formation of large wounds, and is liable to severe and troublesome complications, which the *modern* or *subcutaneous method* obviates.

In performing the subcutaneous division, two instruments are necessary. These are the *straight* and *curved tenotomes*. The blade of the former is narrow, straight, thin and pointed; that of

FIG. 329. Straight Tenotomy Knife.

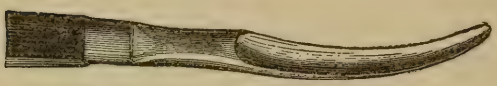


FIG. 330.—Curved Tenotomy Knife.

the latter narrow, curved and blunt, and sharp on its concave edge.

The animal being prepared, a puncture of the skin is made over the tendinous region (carefully avoiding the synovial sacs, as mentioned above), by introducing the straight tenotome perpendicularly between the tendons, until the point of the instrument is felt on the opposite side of the leg. A slight sawing motion of the instrument then cuts through the connective tissue which unites them, and permits the introduction of the curved tenotome into the tract made by the straight instrument, and the latter is slowly withdrawn. At this point the leg is carried into excessive extension by the assistants, by means of ropes secured respectively, one about the knee, and one about the foot, and pulling that of the knee backward and that of the foot forward. The fetlock being thus stretched to its utmost, the operator, with the edge of the curved tenotome turned toward the deep flexor, makes a slight sawing motion with the instrument, and cuts through the fibrous structure from behind and forward, a peculiar crackling sound indicating when the section is accomplished. The retracted extremities of the tendons can now be felt with a wide interval between them, and the straightening, more or less, of the fetlock gives further proof that the operation is completed.

This is the method in *simple tenotomy*. Some operators have suggested the introduction of the instrument between the suspensory ligaments and the perforans in preference to the mode we have described, in which case the section of the tendon must be made from before backward. It is, however, a complicated process, and one which is not without danger of injuring tissues which ought to be left intact. The mode of operating known as the Bernard method is based on this principle.

The *double tenotomy*, though considered at first as a severe

operation, does not involve as many objections as at first thought, but, on the contrary, has often been followed by very satisfactory results. It is, therefore, a justifiable operation when the deformity of the fetlock is quite extensive. In fact, it is unavoidable when both tendons are united, or when the deviation in the direction of the bony levers is caused equally by the common contraction of both. In performing this double tenotomy, the division of the deep flexor being made by the manipulations already described, the curved tenotome being still retained in the wound between the tendons, the operator simply reverses its position in order to bring the cutting edge in contact with the superficial tendon, and completes the operation precisely as already described. In this division of the tendon great caution must be observed, in order to avoid making a complete transverse section of the skin. Double tenotomy is also performed in some cases by introducing the tenotome between the suspensory ligament and the tendons, and dividing them by a section made at once through both from before backward.

In some peculiar cases, besides the division of the two tendons, that of the suspensory ligament has also been included, sometimes in connection with the tenotomy, and sometimes independently. In this case, the place selected differs from that which is indicated for the simple or double operation. It is, indeed, toward the lower extremity near the bifurcation, and toward the lower third of the cannon, where it is more readily reached. The straight tenotome is first introduced, flatwise on either the internal or external face of the leg, between the ligament and the deep flexor of the phalanges, carefully avoiding the blood vessels and nerves, and the curved instrument is inserted with its cutting edge toward the ligament, the section being made by cutting from behind forward. The instrument must not be introduced between the bone and the ligament, nor must the section be made from before backward; such a course not only endangering the nerves and blood vessels, but also involving the risk of breaking the blade of the tenotome at the bottom of the wound.

Whatever mode may have been followed, and however many tendons may have been divided, or whatever force may have been applied to the rope by the assistants who made the traction, it is an exceedingly rare result to obtain a perfect straightening of the leg, most especially when the disease has been of long continu-

ance, and chronic adhesions may exist. A short walking exercise following the operation may facilitate the straightening of the leg, and in any event can have no injurious effect. But even with this, it is sometimes several days before any well-marked improvement can be discerned. There are cases, indeed, when ten or fifteen days may pass without noticeable change, but if it fails to appear after such a lapse of time, the case may be considered hopeless.

There are practitioners, however, among whom are Didot, Delward and Hering, who object to this exercise, and hold that the natural and spontaneous straightening of the fetlock can be greatly assisted by proper shoeing, as, for example, by wearing a shoe with a long toe, such as are used in cases of club-foot, or again, by having peculiar movable toe-corks by which the effect of the bearing of the shoe is increased. The ordinary long-toed shoe represented in Fig. 333 is often worn with advantage.

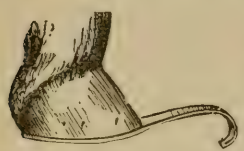


FIG. 331. — Shoe with Prolonged Toe, for Club-Foot.

FIG. 332.—Movable Toe-Cork.

FIG. 333.—Long-Toe Shoe.

Complete rest after the operation will benefit the patient in the most essential manner by diminishing the causes of pain and favoring the cicatrization, and possibly preventing an exaggerated extension at the fetlock. It is only after from twenty to twenty-five days that moderate exercise may be allowed, and not less than six

weeks should elapse before the ordinary labor of the patient can be resumed. The resulting wound needs no special dressing, and by being thoroughly sterilized by antiseptic manipulations, the parts will heal without trouble. The suggestions of poultices, fomentations, counter irritation, blisters and firing of old-time surgery must be strictly ignored.

If, however, all the measures recommended for the straightening of the leg should fail, and, on the contrary, a tendency to an

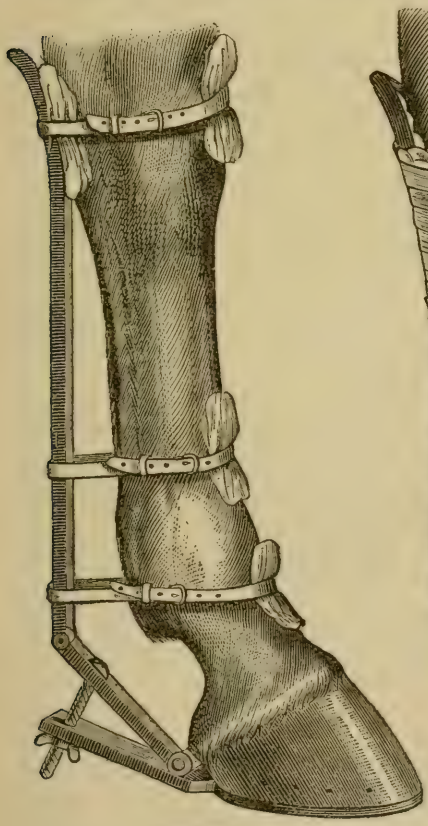


FIG. 334.

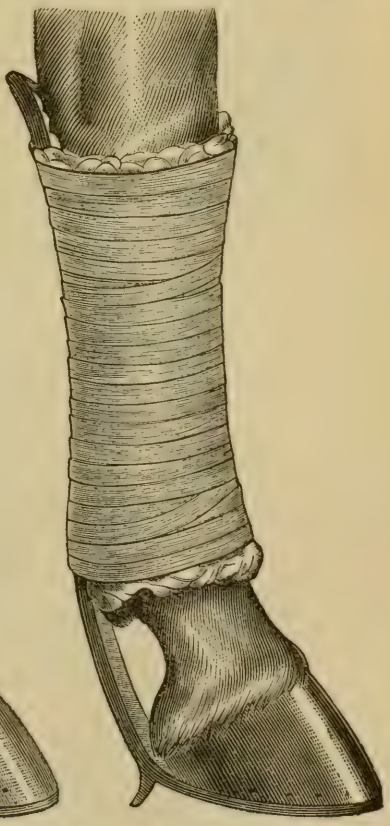


FIG. 335.

FIGS. 334, 335, 336.—Various Apparatus Recommended after Tenotomy.

excessive extension of the fetlock should be manifested, the application of some of the various kinds of apparatus designed for the correction of these defects may be experimentally tried, with a

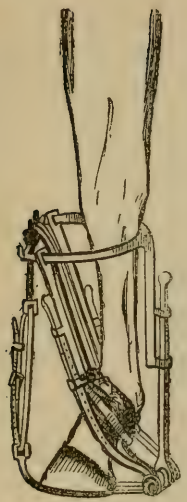


FIG. 336.

possibility of good results. According to their peculiar working arrangements, slowly increased extension might be maintained, or the leg might be steadily retained in a given position, or with the power of regulated motion, the result being an important and permanent improvement in the value and comfort of the animal.

The accidents which may be apprehended in connection with plantar tenotomy are *hemorrhage* and *wounds of nerves*, or *of the skin*, or *of the synovial sacs*; an *exaggeration of the extension, and a return of the original deformity.* To these Peuch and Toussaint add *gangrene.*

(*a*) *Hemorrhage*, both arterial or venous. But this may be avoided by careful attention to the rules laid down for the operation, and if it should occur, hemostatis by pressure must be resorted to, and the bandage can be safely removed, or at least the pressure diminished, in from twelve to twenty-four hours.

(*b*) *Wounds of Nerves.*—These cannot very well be avoided, and while they are manifested by severe struggles of the animal at the moment of their occurrence, they involve no danger other than those pertaining to similar injuries in other regions, viz.: the temporary suspension of the sensorial functions.

(*c*) *Wounds of the Skin.*—These are among the comparatively severe complications, and when they occur, they destroy all the advantages which properly accompany the operation as a subcutaneous process. They are likely to complicate the operation with fungoid growths upon the stumps of the tendons, abundant suppuration, ugly cicatrices, etc., and should therefore be specially guarded against.

(*d*) *Wounds of the Tendinous Bursæ.*—These may be attributed to an improper selection of the place where the puncture should be made, and may be recognized by the flow of synovial fluid from the wound. Suppurative synovitis may then complicate the case with fatal effect. The treatment they require is that directed for open synovial tumors. Local applications, rest, pressure, counter irritation, blisters and firing are the indications.

(*e*) *Exaggeration of the Extension.*—This may take place when artificial means to produce sudden extension are too powerful, or when the violent efforts of the animal have caused a tendency in the parts to give way suddenly. The apparatus before referred to must be here brought into requisition.

(*f*) *Return of the Original Deformity.*—This results from the retraction of the new tissue formed between the stumps of the divided tendon. It occurs as a consequence of returning the animal to his work at too early a date, and when the newly formed tissue has not yet become sufficiently matured and solidified to sustain the strain to which it had been subjected. Rest, cold water bathing in a running stream, vesicating applications and firing have been recommended as remedies, and even a second section of the tendon may be suggested, though with but a doubtful prospect of good results.

Carpal Tenotomy.

This defines the section of the tendons of the external and oblique flexor muscles of the metacarpus. They are inserted on the trapezium bone of the carpus, and their retraction occasions the deformity known as *sprung knees*, a condition brought on by excessive and exhaustive labor, though there is a class of patients in which the lesion may be ascribed to a *congenital taint*, and it is principally for the benefit of this class of patients that the operation is indicated and usually performed. It is principally favored and utilized in Germany, where it was originated by Dieterichs, though afterwards adopted and practiced by Prudhomme, Lafosse, Miguel, Brogniez, Hering, Gourdon and others. The operation can be performed on either tendon singly, or on both; but according to Hering, the division of the external muscle is generally sufficient.

The anatomy of the region should be described before passing to a detail of the steps by which the section of the tendon is effected. The external flexor is situated on the posterior external part of the forearm, and terminates by the branches, one of which, the funicular, is anterior, and passing in the groove of the external face of the trapezium, becomes attached to the hand of the external rudimentary metacarpal bone; while the other posterior, wide and short, goes to the supero and posterior circumference of the same bone, in connection with the middle flexor, to which it is

united. The section must be made above the bifurcation of the tendon, to avoid the artery which passes under it, though it is quite deeply situated, and besides, there is no danger of injuring the synovial sac of the carpal arch. The oblique flexor is situated back and inside of this, and has its tendon single, terminated on the trapezium, with the posterior tendon of the external flexor. The section must be made before the union of the two tendons, in order to avoid injury to the carpal arch.

The animal is thrown, and the knee extended with two ropes, one above and one below the knee, and drawn in opposite directions. The same instruments are used for carpal as for plantar tenotomy.

The incision of the skin is made about two inches above the knee with the straight tenotome, immediately in front of the tendon, which is easily felt under the skin, and is raised with the fingers; the curved tenotome is inserted between the skin and the tendon, from before backward, and the section made as in the plantar operation. Gourdon suggests the introduction of the knives under the tendon instead of between that and the skin. By this mode the division is made from within outward, while in the other way it is made from without inward.

The external flexor being thus divided, the section of the middle flexor is made a little below; the puncture of the straight tenotome is made between the two tendons, and the curved tenotome inserted as before, between the skin and the tendon from before backward, or preferably, from without inward, and when its blunt end is felt on the posterior border of the muscle, the section is made from without inward, with the usual motion of the knife. Only a simple dressing is required, but the animal must be kept at rest for at least a month.

The *modus operandi* to which we give the preference over that which we have just narrated, and which we have described in our work on lameness, is very simple. The animal being thrown, on the side opposite to that of the operation, and the knee extended as usual, the operator, who is in front of the knee, feels for the space between the two muscles, where they are about to unite, and this being found, a straight tenotome is introduced through the skin from before backward, about two inches above the superior border of the trapezium, and under the thickness of the middle flexor, and when the point of the instrument is felt on the

other border of the muscle, in front, the curved tenotome is inserted and the straight one withdrawn, and the tendon divided from within outward; the straight tenotome is then re-introduced through the same opening, between the muscles, and carried from behind forward on the posterior border of the external flexor, under its thickness, until the point of the instrument is felt on the anterior border, when the curved tenotome is again re-inserted, and the division of the tendons performed as before. The wound of this operation is simple, heals readily, and is liable to no complications or accidents. Of course the operator must exercise due caution, when dividing the tendons from within outward, to avoid making a complete section through the skin.

Anti-Brachial Tenotomy.

This operation has been recommended for the relief respectively of sprung knees and knuckled fetlocks, but by reason of the numerous and almost constant failures by which it was characterized, has been discredited, and banished from the domain of our surgery. It consisted in the section of the tendinous band which from the lower extremity of the coraco-radialis extends downward to mingle with the fibres of the anti-brachial aponeurosis, in passing a little below and in front of the elbow joint.

Brogniez, who recommended the operation, performed it by making a longitudinal incision of the skin over the course of the tendon, which is readily felt under the skin, and passing the point of a convex bistoury over the aponeurosis and the band, dividing it from without inward.

Tarsal Tenotomies.

Two modes of operation are practised upon some of the tendons surrounding the hock joints, one upon the cunean branch of the flexor metatarsi muscle, the other upon the tendons of the lateral extensor of the phalanges. They are known distinctively as the *cunean* and the *peroneo-phalangeal tenotomy.*

(*a.*) *Cunean Tenotomy.* — The flexor metatarsi, one of the muscles of the anterior tibial region, is composed of two portions, one muscular, the other tendinous. The tendinous portion is situated between the muscular portion and the anterior extensor of the phalanges, and is attached above to the inferior extremity of the femur, between the external condyle and the external

border of the trochlea of that bone, and passes in the groove situated between the anterior and external tuberosity of the superior extremity of the tibia, downward to the hock, where it rests on the anterior face of that joint and is attached by two branches, one to the cuboid, on the outside of the hock, the other to the superior extremity of the principal metatarsal bone. The muscular portion, which rests on the external face of the tibia, from the upper part of which it takes its origin, terminates inferiorly by a tendon which passes through a ring of the tendinous portion, and becomes more superficial, and then divides into two branches, a large one, which goes to the superior part of the principal metatarsal bone, in uniting with that of the tendinous portion, and another, smaller, which bends inward, to terminate at the small cuneiform bone. This branch is chosen as the seat of operation.

The operation recommended by Abildgaard and Viborg, was indicated by Hertwig, and at a later period performed by Lafosse, Hering, Mantel, Grad, Bugniet and Dieckerhoff. It is very commonly performed on this continent, and, like many other operations at the time of their first introduction, has been both used and probably abused to such an extent that it has not yet received the credit to which it is fairly entitled.

FIG. 337.—Cunean Branch of the Flexor Metatarsi.

It is indicated for the relief of the pressure which this branch makes upon the distended periosteum of the enlarged tarsal exostoses known as spavins, and when the exostosis is, strictly speaking, the only lesion in the hock, it will prove essentially beneficial. But if, with the new growth of bony deposits, the joint itself should be involved, and some of the articular diseases should be present, the result, so far as the removal of pain and lameness is concerned, is not always certain. Although more or less satisfactory at times, in many instances it entirely fails. The difficulty of positively diagnosing the condition of the articular surfaces justifies the surgeon in operating, when the tense condition of the tendon, its pressure upon the exostosis, and the irritation of the synovial sac

which aids its movements, which it produces, point with certainty to the cause of the lameness.

The instruments necessary are scissors, a straight and a convex bistoury, a dissecting forceps, a curved director, and perhaps a curved tenotomy knife.

The animal is cast on the side of the leg to be operated upon, the upper leg carried forward and secured on the upper forearm, and the hair clipped over the tract of the tendon, which can be readily identified by an oblique groove generally found running on the upper portion of the bony enlargement. An incision about two and a half inches long is made with the convex bistoury, either parallel to the tendon, or slightly oblique, and right

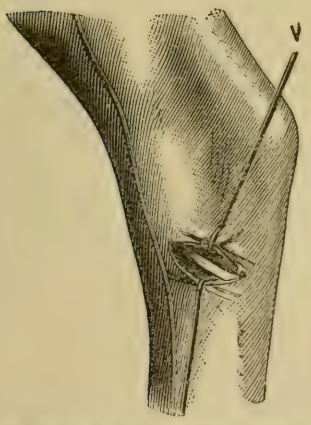


FIG. 338.—Tarsal Tenotomy. Cunean Tendon Exposed.

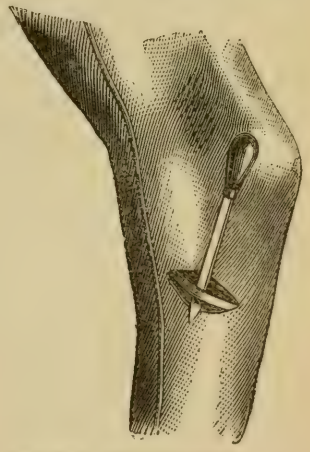


FIG. 339.—Tarsal Tenotomy. The Tendon Raised.

across its direction. This incision is generally accompanied by a somewhat troublesome capillary hemorrhage, which ought to be controlled before proceeding further. The tendon may then be felt through its bursa, which is raised with the dissecting forceps and opened, when the tendon is readily exposed. The curved director is then inserted under the tendon, which is easily raised from its tract, and by guiding the tenotome along its groove the section is made by a single stroke.

Some practitioners complete the operation by amputating a portion of the tendon. This is unnecessary, and complicates the operation by subjecting the parts to the necessity of a repairing

process, which is not needed for the result of the operation, and exposes the animal to a complication of inflammation of the synovial bursæ which ought to be avoided. To obviate these dangers, Dieckerhoff is of the opinion that the division of the bursa is all that is required, and states that he has often secured good results, from that alone, without the section of the tendon.

Besides this mode of operating, which may be called the *open incision*, there is another procedure by *subcutaneous* division, which is also recommended by some, but the difficulty of discovering the tendon in its bony groove, and in reaching it properly, and the possible complication of subsequent inflammation of the bursæ, will probably secure the preference for the method by open incision. The operation is completed by closing the wound with a stitch of suture, and protecting it with antiseptic dressings. The results of the operation are sometimes immediate, though in some cases not apparent for a few days, but if after the lapse of two or three weeks the lameness has not either disappeared or greatly abated, it may be safely concluded that it is attributable to some cause other than the pressure of the tendon.

(*b.*) *Peroneo-Phalangeal Tenotomy.*—Though the true pathology of the peculiar affection of the hock joint known as springhalt, and the cause that excites the spasmodic action characterizing it, are far from being satisfactorily known, it has been observed that in animals thus affected the tendons of the extensors of the foot in front of the hock have a tense or rigid character, which renders them unusually prominent; and it is this symptom which suggested to Brocar, a Belgian veterinarian, the division of the tendon of the lateral extensor of the phalanges, or peroneo-phalangeal muscle, as a means of cure. Brocar, Brogniez, and Delwart performed it, and have recorded their success in numerous cases.

The lateral extensor of the phalanges terminates inferiorly by a round tendon, which passes into the groove situated on the outside of the lower extremity of the tibia, in a sheath formed at the expense of the superficial external ligament of the tibio-tarsal joint. In this sheath it bends forward and downward to join the tendon of the anterior extensor toward the middle of the metatarsus, which it crosses downward, forward and inward.

The operation is of the simplest nature, and may be performed with great facility. The animal being cast, and the section com-

pleted through a small incision made over the tendon, a little below the hock, and near its junction with the principal extensor, about one inch of the tendon is removed. Sometimes the action of springhalt ceases at once, when the animal is allowed to rise to his feet. Other cases require a few days for the completion of the cure. The simple operation has proved satisfactory in our hands in two cases.

Tenotomy in Birds.

The operation is performed in this instance with the object of preventing the animals from flying, and consists in the section of the tendons of the extensor muscles of the carpus and phalanges. The bird is held by an assistant, with its wing extended, and a few feathers are pulled out from each side of the carpal joint, as well as in front of the radius, to expose the skin, through which the extensor tendons, two in number, are readily seen. A small incision being made through the skin, the tendon is raised with forceps, and a portion of it amputated, the operation being repeated on the other side of the wing upon the extensor tendons of the digits, between the radius and the cubitus. The treatment is applied to both wings; it is without hemorrhage, and the wounds heal in two or three days.

CHAPTER VIII.

OPERATIONS ON THE DIGESTIVE APPARATUS.

ON THE TEETH.

The office fulfilled by the dental system in the preliminary preparation of the ingesta, and the first step in the process of digestion, is necessarily one of the utmost importance. Of course, therefore, any diseased conditions which may interfere with its efficient action, especially with the herbivorous animals, become matters of deep interest to the veterinary practitioner. All facts and circumstances concur to establish and substantiate the claims of that branch of veterinary science which refers to the care of the teeth as a very important specialty, and we shall, therefore, so estimate and so elucidate the subject of veterinary dentistry, so successfully studied and so largely developed in recent years by American veterinarians.

The diseases of the teeth to which our domestic animals are subject may be due to various pathological conditions. The dental arches formed by their arrangement in the jaw may be the seat of congenital deformity; the teeth may possess abnormal qualities in respect to their number, their shape and their direction; or, again, in the condition of their grinding surfaces, and there may also be special diseases of the elementary substances of the tooth itself.*

The abnormality which exists in relation to the number of the teeth is of not uncommon occurrence in horses, in which animal we sometimes discover the presence of supplementary molars, resulting either from the persistence of a temporary tooth which has failed to be shed at the proper time, or may be due to an excess of development in the evolution of a dental follicle, as we may observe in the formation of the *wolf tooth.*

In relation to the shape of the dental arches, there are cases

* We take pleasure in recommending, in connection with this subject, the excellent little work on *Horses' Teeth*, written by Mr. William H. Clarke.

where, instead of presenting the regular and correct natural lines, the upper and lower molar arches so far disagree as to render their perfect coaptation impossible, and render the execution of their function to a great extent impracticable. The direction or implantation of the teeth is, at times, so far irregular and abnormal as to change the frictional surfaces in such a manner as to remove the wear and abrasion from the crown to the surface of the organ. In relation to the disposition of their rubbing surfaces, it is well known that on account of the difference existing in the consistency and power of resistance, two of their elements, the enamel and the dentine, their frictional surfaces become rough, irregular and *sharp;* and, as they sometimes assume excessive dimensions, they may give rise to serious phenomena, especially when they have their seat in a part of the dental arch where no resistance can be offered to their development, as when the corresponding tooth of the opposite jaws becomes diseased or absent.

The special diseases of the elementary constituents of the teeth exist in the depth of their substance, and consist in caries or ulceration of the tooth, the affection involving the dental pulp itself, with other diseases pertaining to the *alveolo-dental membrane*, all of them being accompanied by a series of well understood symptoms, severely distinctive in their character, and which in the majority of cases call for the assistance of the veterinary dentist in order to relieve the suffering animal from the distress in which his human master knows but too well how to sympathize.

The symptoms pertaining to the various conditions above alluded to may be either common, or *general*, or *special.* Among the general symptoms, the first to be observed is a change in the style of performing the function of mastication, proportional to the sensitiveness occasioned by the dental lesion. Thus it is observed that although the animal seizes his food with the same avidity as if his teeth were in good order, the motion of his jaws, the chewing of the food, are slowly and carefully performed, the lateral movements of the lower jaw occurring in a hesitating manner, and often made on one side of the mouth only. In eating hay, the mouthful of the food is never triturated as it ought to be, and before the process of mastication is completed the animal drops it out of its mouth in the shape of a flattened bolus, saturated with saliva, to seize it again and make a new attempt at mastication, perhaps twisting his jaw in different directions in his

endeavor to accomplish the act without pain. The attempt seems, however, to be vain; again the mouth is opened and the same flattened bolus is dropped in the manger, and this continues until the poor animal, suffering and hungry, is seen standing before a rack full of hay for which he both longs and fears to touch. The suffering horse will sometimes swallow his oats imperfectly masticated, but the partial chewing is performed slowly and with difficulty, his manner indicating the pain it costs him; dipping his nose in the manger, chewing on the grain for a long time, and impregnating it with saliva before he swallows it. Soft food, bran and mashes, cooked roots, scalded grains, and the like, are the only aliments that can, without difficulty with this imperfect degree of mastication, enter into the pharynx.

Animals suffering with diseases of the dental apparatus are often affected with colics. At first they may be slight and intermittent, but they soon become more severe and more frequent. They may last for several days, and may be marked by the peculiarity that during their continuance defecation may still continue, though irregular as to time, and the movements scanty in amount, the fœces besides being in small and adherent lumps, and more or less coated. In other cases they are soft, and the animal has a tendency to be washy, and more or less to scour, but in either case the droppings are more or less loaded with unmasticated food. All these symptoms are manifestations resulting from an imperfect digestion.

It is easy to understand that if this condition continues for any length of time the entire economy will suffer from it. The animal looses flesh; his coat becomes dull, dry and staring; his force and ardor diminish; he sweats easily, and all his other functions exhibit evidences of the weak condition of an organism deprived of the nutrition and strength which follow the ingestion of food thoroughly masticated and well digested.

Having recognized these symptoms, which, if not seen by the surgeon, should be brought to his attention through the history of the patient; when intelligently stated, the diagnosis may be considered established. But it becomes positive only after an examination of the mouth, by which the special symptoms pertaining to each alteration are elicited.

The inspection of the mouth, which may be kept open by the use of the various speculums, or by merely pulling the tongue

sidewise out of the way, will, in a great majority of cases, easily lead to the detection of the cause which interferes with mastication.

First of all, when the mouth is opened, a peculiar symptom will be observed, consisting in a change in the salivary secretion. This will be increased more or less, and as the saliva will escape freely, a peculiar acid odor will be noticed proceeding from it, and on looking for the cause of this trouble, if it be one or other of the irregularities already mentioned, such as the projection of one of the teeth, the vicious inclination of their crowns, the sharp edges, etc., critical inspection will soon reveal them. The teeth will be found to be soiled with greenish food-detritus on the side where the difficulty exists, and on that same side the animal will be found to have stored the surplus food which he has accumulated between his teeth and the cheek.

If, however, in consequence of being situated so far back in the mouth that the eye fails to detect the condition of the part, he can complete his examination with his hands. With due practice in this mode of investigation, one may become sufficiently expert in the manipulation of the mouth to dispense entirely with the aid of the speculum; though of course there will be cases when in order to establish a thorough diagnosis of the exact and positive condition of the part, this instrument cannot be dispensed with. There are also conditions where the examination cannot be carried out in the standing position, even with the assistance of means of restraint, and the animal must be thrown down, and even, says Bouley, "placed under the effects of ether. In this condition, the jaws are readily kept open and immobile, the tongue is free from contraction, and the hands and fingers can be carried over the entire length of the dental arches without the slighest danger to the operator."

Manual exploration removes all doubt about the diagnosis, since the surgeon may, by skillfully practicing the taxis, recognize all the irregularities present, whether the vicious direction of the dental surfaces, the uneven wearing of the teeth, the cavities which may exist in their thickness, or the condition of their implantation with that of the alveolar cavity, etc.

When the mucous membrane has been excoriated by the sharp projections of the teeth, when the gums are highly inflamed, and the jawbones have been bruised, and are necrosed and suppurating;

when the saliva which flows from the mouth is abundant, gluey and fœtid in odor; when the mouth is hot, the mucous membrane injected, and in the regions where this diffused inflammation has started, lesions are apparent corresponding to the cause that produced them, such as deep cuts on the internal face of the cheeks, which have been torn by the asperities of the teeth; when there is swelling and redness of the gum at the point where it is inflamed; when there is enlargement of the bone, with a grayish hue at the point where it is exposed and in process of sloughing; or again if these fistulas penetrating the spongy tissues of the maxillary bone —all this becomes evident under the careful and accurate manipulation of the instructed fingers.

Besides the exhibition of the general symptoms belonging to all diseases of the dental apparatus, caries of these organs is characterized by some special characters belonging to them exclusively. Principal among these is the peculiar fœtor of the interior of the mouth and of the saliva flowing from it, which is *sui generis*. There is also the escape from the mouth of this saliva in excessive quantity and in long, slobbering masses. Then there is the existence on one of the faces of the carious tooth, and principally on the crown, of a blackish spot, or of a hole, or of a large excavation, penetrating the substance of the tooth at a varying depth, according to the extent of the disease and the duration of its existence—the violent pain experienced by the animal when the percussion is applied on the tooth, or its cavity explored with the instrument—the swollen condition of the gum surrounding the diseased tooth; its red color; its want of adherence in some places, and the hemorrhage with the oozing of pus when pressure is applied directly over those same places; the soiled appearance of the dental surfaces on the side of the diseased tooth, caused by particles of food remaining adherent to their anfractuosities, and filling up the cavity of the carious tooth, or forcing themselves between the tooth and the gum, and spreading, diffusing the most repulsive odor—these all belong to a carious condition of one or more of the teeth. But if in addition to this the caries is of long standing, and has advanced towards the root of the tooth, the ordinary complications pertaining to its development in the maxillary bone at the alveola take place, and that point becomes the seat of an inflammatory swelling, manifested externally by a painful enlargement, hot and œdematous, which gradually increases,

though at a given time it may remain stationary, hard and resisting. Again, as the progress of the disease continues, the hypertrophied dental root, by its continued pressure outward, may destroy the external surface of the bone, and form a communication between the bottom of the diseased alveola and the external plate of the maxillary. In these cases pus, saliva and putrefied food collect or filtrate into the subcutaneous cellular tissue, and an abscess is formed which soon ulcerates and empties itself on the surface of the cheek. Once open, this abscess has no tendency to heal, but, on the contrary, maintains its fistulous form, and discharges through its opening a mixture of pus, saliva and food, having the very repulsive and characteristic odor already mentioned. Exploration of this fistula with the probe will give different results according as the fistulous tract is straight or irregular. In the first instance, the probe will penetrate directly into the mouth, opening on one of the faces of the diseased tooth, or even passing into the center of its carious crown; while in the other case it is arrested by the spongy substance of the ulcerated maxillary; or it may strike against the root of the diseased molar.

At this point, changes will have taken place in the mouth, upon the surface of the teeth, on the side of the jaw where the disease exists. These changes vary, and consist either in a great obliquity of the tables of the teeth, the crowns or rubbing surfaces being beveled in very oblique and opposite directions, or in the well marked elevation or projection of the molars corresponding to the diseased grinders, in the healthy jaw; a projection which is in proportion to the diminished size of the opposite carious tooth which stands much lower. The first condition is observed when the pain caused by the caries has entirely prevented mastication on the diseased side, and the second, when, notwithstanding the caries, the performance of mastication has still continued.

The condition then presented by the carious tooth may also vary. In some cases it may still be complete in its alveolar connection, though otherwise partly destroyed, and yet firmly adherent by its root. In others it may be broken, entirely or in fragments, merely parts of the outer surface being present; while again, some broken fragments, more or less detached, may remain in the alveolar cavities.

Caries of the first and second superior molars may become

complicated with lesions of the nasal cavities, when the ulcerating process has been followed by a perforation between one or other of these cavities and the mouth. This lesion is accompanied by a discharge taking place on the side of the nose corresponding to that of the diseased tooth. This discharge is of a muco-purulent character, and mixed with saliva and food, which gives it the usual fœtid odor as well as a peculiar green appearance. It is very different from that belonging to glanders, and is too characteristic to justify by its presence an error in diagnosis in that direction. If, however, the same complications take place in the molars, whose roots rest on the sinuses of the head, the symptoms which are manifested are often so nearly similar in aspect to those of chronic glanders, that the commission of an error should not be considered wholly inexcusable. Careful examination will readily bring out the differential diagnosis between the two diseases, though so different in their *ensemble.* When the caries of one of these last molars exists to such an extent as to transform the mucous membrane of the sinuses into a suppurative surface, and to cause the development of granulations upon its surface; or to allow the collection of pus in the cavity of the sinuses, a discharge becomes established through the nostril of the side of the diseased tooth and affected sinus. This discharge is white, grumous, very abundant, and keeps increasing, and has also an extremely fœtid odor, identical with that of dental caries.

The lymphatic glands of the maxillary space then become swollen, hard, though painless, and loose under the fingers. The plates of the zygomatic, of the superior maxillary and of the nasal become swollen, and give a dull sound on percussion. Sometimes their surfaces are so thinned out that it flexes under the pressure of the fingers, and they are then surrounded by an œdematous infiltration of subcutaneous cellular tissue.

The long and minute consideration which we have thus given to the diseases of the dental apparatus has been principally devoted to the molar teeth of herbivorous animals, although many of the conditions observed in the grinders may also be found belonging to the incisors. Indeed, incisor arches may also offer abnormalities in the number of teeth, in their position, and in the direction or the length of these organs, and they may also become the seat of accidental lesions, such as fractures, luxations, or the too

rapid wearing of various parts of their surfaces, though it seldom reaches the point of caries.

The different indications which the majority of these pathological conditions may impose resemble so nearly those required under similar circumstances for the grinders, that it becomes unnecessary to appropriate a special chapter to their discussion, and we therefore proceed to the consideration of the general operations performed upon the teeth, according to the indications which may be from time to time presented.

Operative Dental Surgery.

Two principal indications present themselves under this heading. *First*, the *leveling* of the frictional dental surfaces, for the removal of any existing asperities or sharp projections, in order to establish a perfect coaptation, as well as the free movement necessary for the execution of their function of attrition. *Second*, the *extraction* of the teeth which have undergone such important alterations in their structure, that their conservation becomes incompatible with the regular execution of mastication, or because of the serious complications they may involve.

Leveling of the Dental Arches.—The original mode of operating to level the molar teeth consisted in making the animal chew on the blacksmith's rasp. It is a simple process, easy to perform, without danger to the animal, and so well answering the purpose that even to-day the process is still in extensive use. But this *modus operandi* is not without its inconveniences, among other objectionable points, requiring to be repeated for several days until perhaps the teeth have become smooth by rubbing against the rough surface of the rasp—a result not always as satisfactory as it might be. More appropriate instruments have therefore been invented, though, in point of fact, none of them are other than more or less modified rasps or files, as they are truly called. Their number and variety are to-day very great, and their qualities vary very much, according to the taste, the ideas, and often the dexterity of those who use them. Samples of these files are represented in Fig. 340, and according to their general construction may be classified as rough and fine rasps, flat and angular, guarded, double and single on one or other of their edges. Some are simple, and formed of a single piece, while others are jointed and compound, and may be screwed or unscrewed with facility

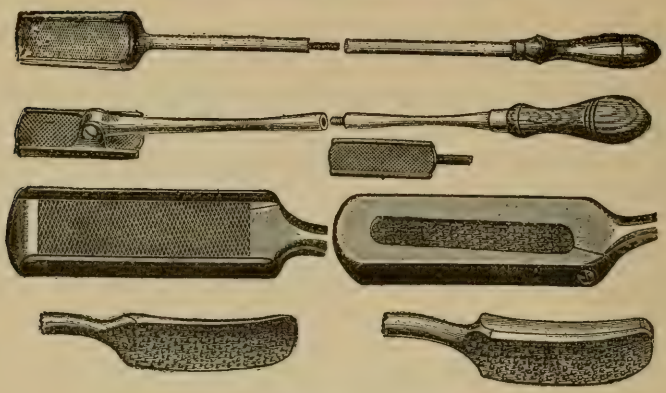


FIG. 340.—Samples of Tooth Rasps.

for use and transportation; some have the rasp fixed to a solid handle, and again, the handle in others is moveable, and may be changed as indications may present themselves. Their number in this country is about incomputable, and while many which we find registered in the patent office are of real value, many others have no reason for being beyond their maker's whim. As we have said, the advantages which any of them may possess depend more on special conditions than on the result to be obtained, in the removal of the small, sharp edges of the external surface of the tooth, or its lateral faces, resulting from an excessive development in the enamel.

Whatever may be the file which the veterinary dentist may see fit to use, the manipulations required in its handling will be in all cases the same. In referring to this, the first question which offers is, whether the use of the speculum is necessary to enable the surgeon to file a horse's teeth? There is no doubt that in many instances it will be difficult, and even perhaps impossible, to compel the patient to keep his mouth sufficiently open to permit the use of the rasp with the necessary delicacy and freedom, or prevent him from constantly biting it, or keeping his jaws closed during the operation. In every instance, the play of the instrument will be sure to be interfered with by the excited patient.

We believe that American practitioners were the first to dispense with the speculum in these cases; and that to Mr. House, a celebrated veterinary dentist, who died not many years ago, is due, in fact, the paternity of this specialty in veterinary surgery.

Whether the mouth of the animal is held open with a specu-

lum, and the tongue drawn out and held on one side by an assistant, or whether the operator himself controls the tongue with one hand while working the instrument with the other, the manipulations must be the same, viz.: the passage to and fro of the file over the surfaces requiring to be corrected, wherever they are rough and sharp; filing them just as the smith files the iron he is shaping as he holds it in the vise. We believe, however, that the rasping out ought to be done slowly, softly and without giving the animal any cause for fright or excitement. The method sometimes practiced of using the rasp with a succession of rapid movements over the dental arches is certainly dangerous and liable to be accompanied with accident to the patient. An irritable, struggling animal, by violent movements of the head, or in his attempts to chew on the rasp, may easily receive injuries from the rough contact of the instrument with the delicate structures of the mouth. After such a passage of the rasp a number of times over the teeth, the hand introduced in the mouth will at once detect the effect upon the patient.

Although the use of the speculum may be advantageous in many instances, there is certainly a risk attending its use, in the possibility of bruises and lacerations which may occur at the bars when the animal, annoyed by its application, chews upon it in his endeavors to close his mouth.

The work of *filing* when the teeth are sharp is of common indication, and finds its direct application under the special condition that the edges or asperities which are treated should not be too large or too prominent. If this should be the case, and the inefficiency of the file or rasp, however, become evident in the trial, other means remain for accomplishing the desired purpose. Such a contingency was not lost sight of in former years, and chisels and gouges were then employed to reduce the excessively developed projections of enamel.

With these instruments the patient was either thrown or treated on his feet, his mouth being opened with a speculum, with his tongue drawn out and held on one side. The chisel was then laid against the dental projection, and an assistant striking it with a hammer, the excess of tooth was knocked off. Bouley considered this mode of operation dangerous. "The chisel might, under the impulse received by the hammer, slide in the mouth and severely injure the tongue, the cheeks, and the soft or the hard palate; or

in animals advanced in age, the tooth might be fractured or dislocated; or again, the operator himself might be injured by the instrument, when, suddenly displaced by a movement of the animal, the assistant knocks against it."

It was to remedy this objection that Brogniez invented his *odontritor* (Fig. 341), an instrument which carries on one end a blade sharpened on both edges, and on the other is hollowed out, in order to allow the play of a rod through one-half of the length of the instrument. This rod is provided with a transversal handle, which also acts as a hammer, by which the blow is carried against the sharp edges of the tooth.

When the odontritor is used, it is not necessary to use a speculum to open the mouth, the holding of the tongue out of the mouth being sufficient. The operator, holding the instrument with the left hand, places the anterior sharp edge against the projecting portion of the tooth, and holding the rod by the handle full in his right hand, moves it to and fro, striking at the proper points as he moves it. This operation is repeated on both jaws until all the sharper edges of the teeth have been cut off, and is completed by passing the rasp over the dental plates, as is done when the teeth are not too sharp.

Several modifications have been made in the conformation of the odontritor, but that of Prangé is probably the best (Fig. 342) It consists in having three blades, which may be changed at will and which vary in the form and disposition of their cutting edges. This instrument is considered superior to that of Brogniez, and is thought to work to better advantage when the elevation of the tooth is well marked.

The odontritor answers perfectly for leveling the molars when the projections are not excessively developed, or do not offer too great resistance to the action of the blade. But when an entire tooth projects above the general level, the odontritor ceases to be of any advantage, and it becomes necessary to perform the *resection* of the tooth, consisting in the removal of all that portion of it which rises above the level of the general dental surface.

To Brogniez is due again the first instrument invented for the performance of this operation in the *chisel odontritor* (Fig. 343). This is composed of two rods, one of them having at one end, like the ordinary odontritor, a frame of sufficient dimensions to allow the entire molar to pass through it, and on the anterior border of

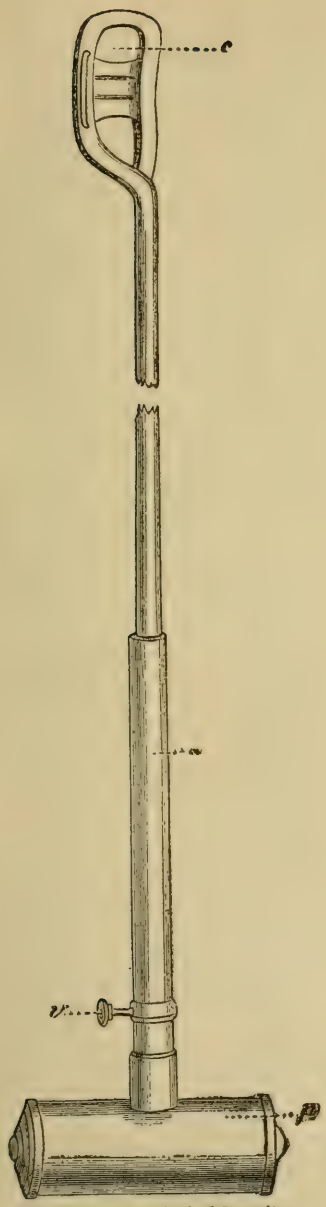


FIG. 341.—Brogniez's Odontritor.

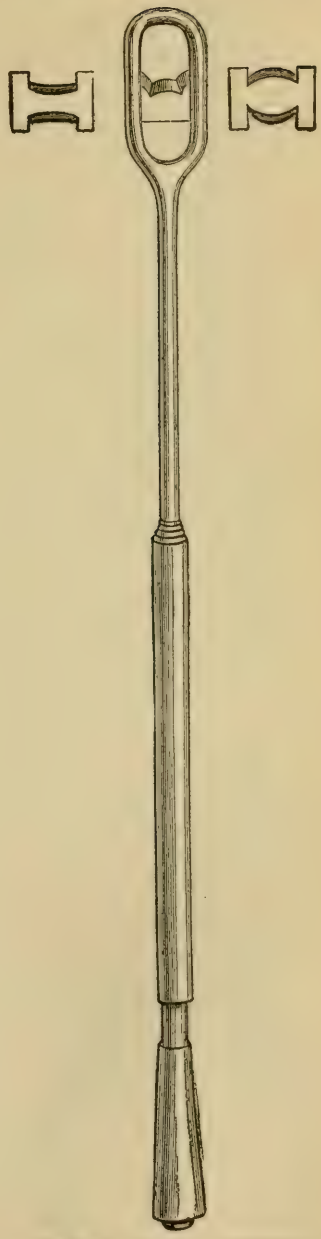


FIG. 342.—Prangé's Odontritor.

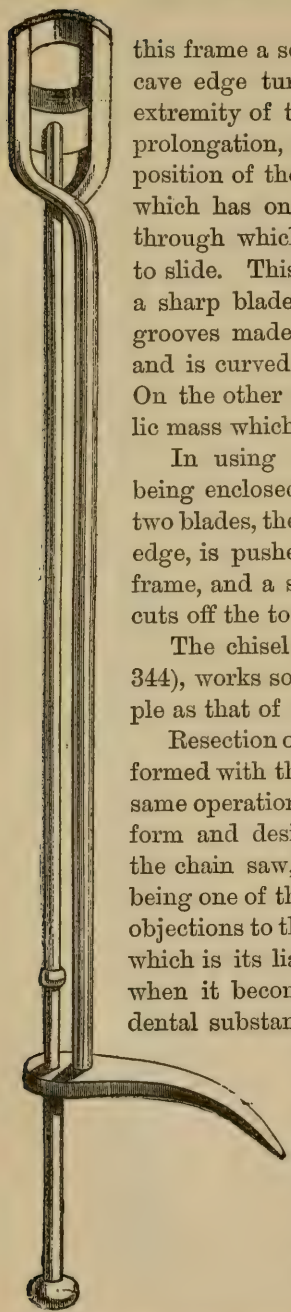


FIG. 343.—Brogniez's Tooth Chisel.

this frame a solid blade with a sharp concave edge turned backward. The other extremity of this rod carries a transverse prolongation, which serves to change the position of the blade when necessary, and which has on its shorter portion a hole through which the other rod is allowed to slide. This second rod has on one end a sharp blade which slides into suitable grooves made in the frame of the first, and is curved forward on its front edge. On the other extremity it carries a metallic mass which is used as a hammer.

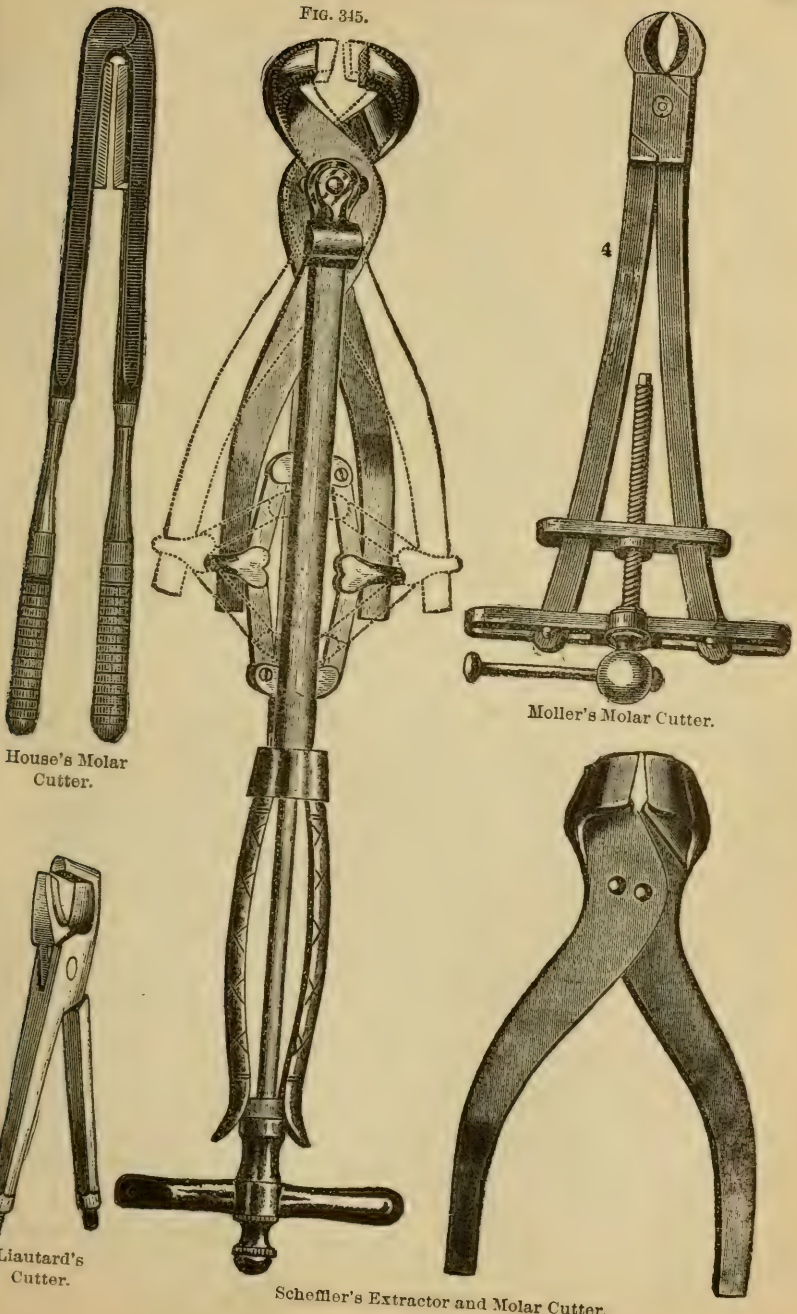
In using this instrument, the tooth being enclosed in the frame between the two blades, the movable rod, with its sharp edge, is pushed against the blade of the frame, and a strong blow of the hammer cuts off the tooth smoothly and evenly.

The chisel invented by Gowing (Fig. 344), works somewhat on the same principle as that of Brogniez.

FIG. 344—Gowing's Chisel.

Resection of the teeth has also been performed with the instruments used for the same operation on bones. Saws of various form and design are also recommended, the chain saw, which we have often used, being one of these. But there are serious objections to this latter instrument, among which is its liability to become heated while in use, when it becomes unable to "bite" upon the hard dental substance, and may, moreover, break or slide. The only method of overcoming these objections, which, in fact, may occur in using any kind of saw, is by holding a wet sponge against the tooth to which the instrument is applied—a precaution which is not always of easy adoption, and which can scarcely be effected without more or less danger of wounding the hand which holds

FIG. 345.



House's Molar Cutter.

Moller's Molar Cutter.

Liautard's Cutter.

Scheffler's Extractor and Molar Cutter.

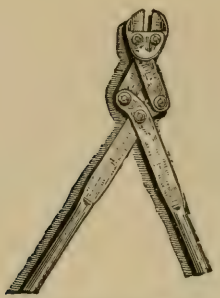


FIG. 345*a*.—Hamlin's Molar Cutter.

the sponge. But when none of these modes of operation can be readily applied, the use of the *tooth-chisel* becomes the order. Its application is simple, and with a well-made instrument in the hands of an expert operator, quick and strong, the resection can be readily performed.

The array of tooth-chisels or resectors is beyond compute in variety and number, and especially in this country where the instinct of mechanical invention is so universal, and the specialty of veterinary dentistry is so extensively practiced, and many different kinds can be inspected among the samples of workmanship which decorate the show-cases of our instrument makers. Among the principal forms, we may, however, mention those which recall the names of Lafosse, Moller, Scheffers, Gowing in Europe, and of Clarke, House, Liautard and Hamlin in this country (Figs. 345, 345*a*). Some of these instruments have their jaws closed, others have them open. Some work by a peculiar thread-screw arrangement, others by the manual power of the operators; and again, the blades of some are straight and others curved, and still others are sharp like a concave saw. In their application they all work upon about the same principle, and are used in the same manner. The mouth being opened, the tooth is seized between the jaws of the forceps, and by the pressure of the screw with which some of them are armed, or by the unaided strength of the operator, the tooth is squeezed and cut off with a sudden snap, followed by the dropping out of the mouth of the amputated portion. As a rule, the surface left on the tooth shows but a slight roughness, which can be smoothed off with the rasp.

Extraction of Teeth.

The extraction or removal of teeth is indicated for the reduction of any excess in their number, which may interfere with mastication; or when these organs are abnormal in form or direction, and obstruct the growth or usurp the place of a permanent tooth; or when they are diseased with caries, or affected with any of the pathological conditions which we have before considered; or when they become the cause of a dental fistula.

To extract the incisors of any of our domestic animals, the molars of dogs, or the caduc molars of large herbivorous animals, some of the various forms of tooth forceps that are used in human

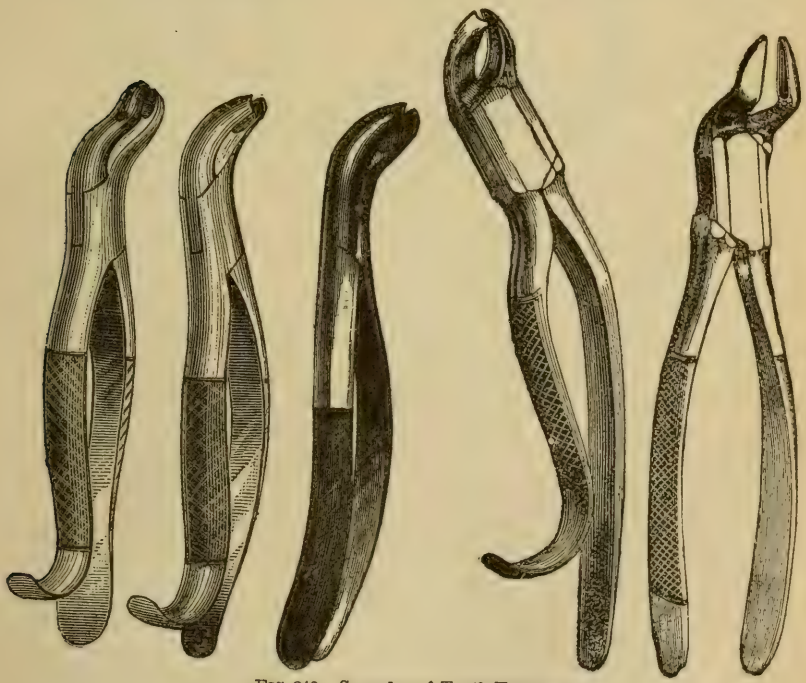


Fig. 346.—Samples of Tooth Forceps.

dentistry or the different shapes of the key of Garangeot or special larger forceps, such as that of Lecellier (Fig. 348) or the enlarged Garangeot's key, as modified by Delamarre (Fig. 349), will be necessary. The *modus operandi* is generally simple; the tooth, still firmly attached to its alveola, or perhaps loose and more or

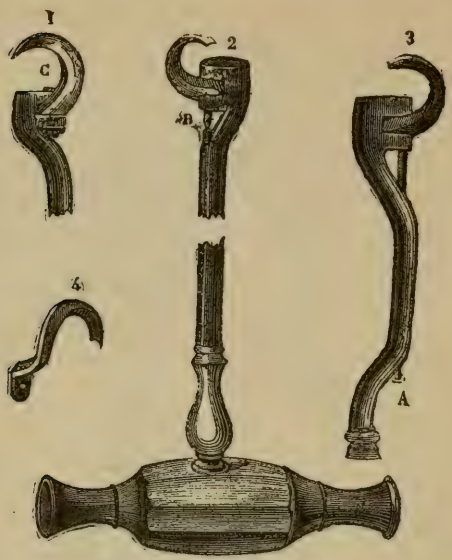


FIG. 347.—Garangeot's Keys.

less pushed out of its place by a succeeding growth, is seized between the jaws of the forceps, or of the Garangeot's keys, and is easily wrenched from its position by a strong pull or with a slight twisting motion sufficient to lacerate its last adhesions.

The extraction of the permanent molars of a horse is a difficult and, under some circumstances, a serious operation. Their mode of implantation and insertion in the alveolar cavities; the great length of their roots as compared to the small dimensions of their free portion; the narrow connections which exist between them, and withal, the solidity of the dental arch—all these conditions are sufficient to explain the serious character of the prognosis of this operation, and the difficulties which are often encountered when the organ to be removed is the molar tooth of a horse. These difficulties, however, vary considerably under peculiar conditions, such, according to Peuch & Toussaint, as "the age of the subject, the position of the tooth on one or the other jaw, and the degree of alteration of the tooth to extract."

For example, the operation is more difficult in young animals than in adult, or older subjects, the latter requiring less effort, the root of the tooth being shorter and the adhesion to the alveola less solid. The upper are less firmly attached than the lower

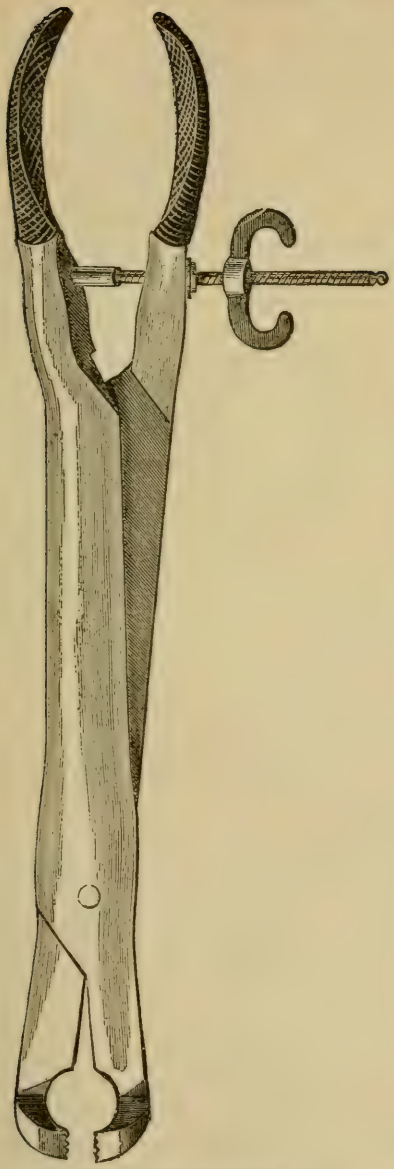


FIG. 348.—Lecellier's Tooth Forceps for Molar.

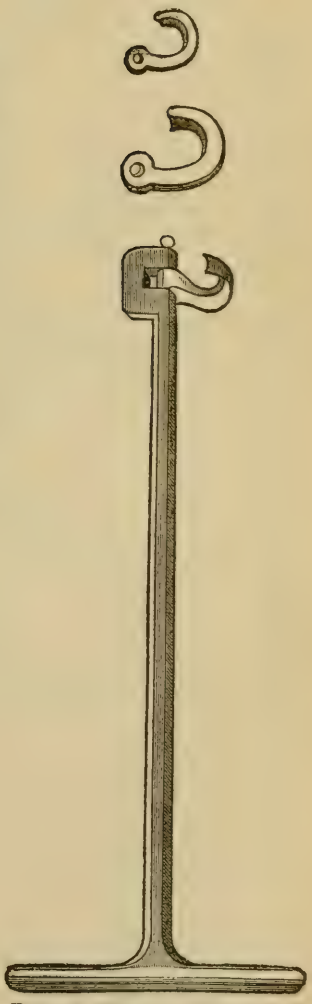


FIG. 349.—Garangeot's Keys, Modified by Delamarre.

molars, the presence of the cavities of the sinuses, and the diminished thickness of the walls of their alveola rendering their

insertion and implantation less tenacious than in the lower. The extraction of the front is less difficult than that of the posterior molars. At times, as when the teeth are partly destroyed by caries, a single effort will be sufficient to extract them; but in other cases, as when the periosteum is diseased, and the roots adhere more intimately to the alveola, the extraction becomes very difficult. And again, if the tooth having a hypertrophied root, resists the action of the instruments through the opposition of those immediately surrounding it, which, though healthy, are less firmly fixed in their alveola, which are mechanically dilated by the outward pressure made upon the plates of the maxillary bone, is easy to loosen and dislocate them; and this is a circumstance which must not be overlooked during the manipulation required for the extraction, in order to avoid serious disturbances of the dental apparatus.

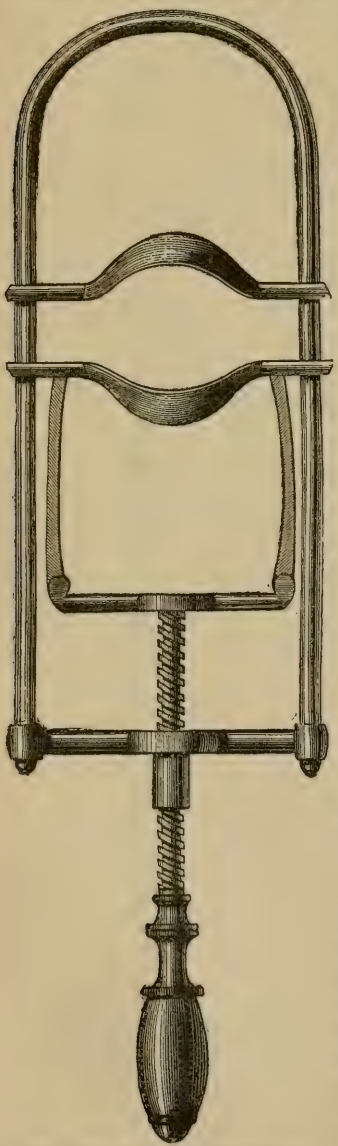


Fig. 350.—Speculum of Lecellier.

In the extraction of a molar, the patient must be thrown, and the head well elevated, the mouth being kept well open by means of a perfectly safe speculum, such as that of Lecellier (Fig. 350), but we think it rather clumsy to handle. Bouley recommends the etherization of the patient. The mouth is to be thoroughly cleansed. There are circumstances, however, in which the operation of casting is unnecessary, and, in fact, our own personal experience has raised doubts in our mind as to the necessity at any

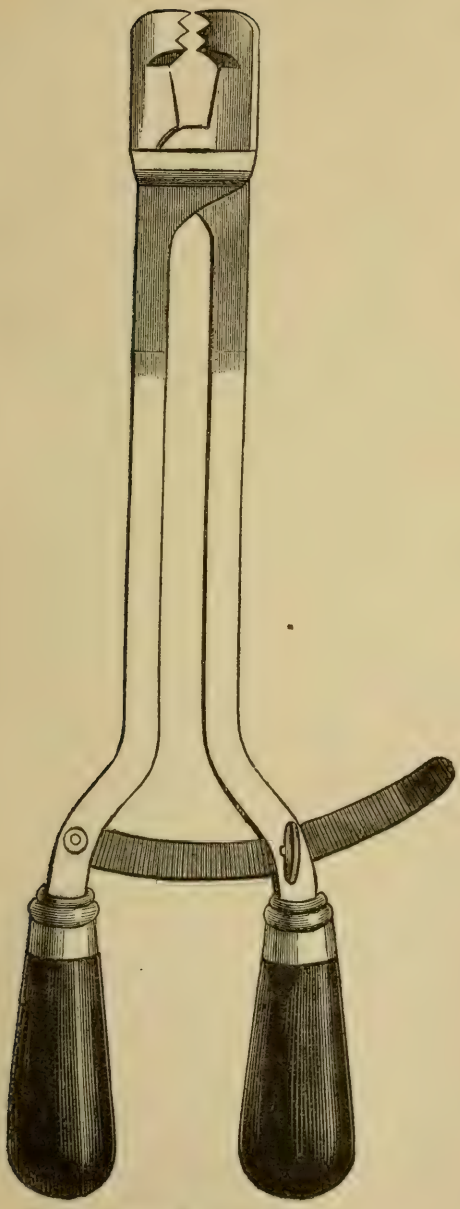


FIG. 351.—Plasse Molar Extractor (full view).

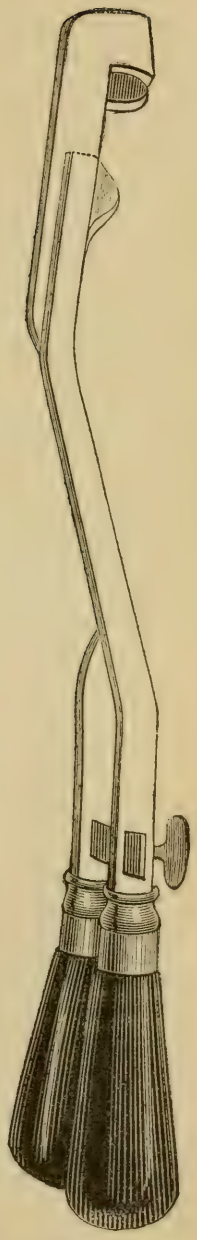


FIG. 352.—The same (side view).

time of exposing the animal to the possible accidents which may attend this mode of restraint. We hold strongly to the expediency of performing the operation in the standing position. There will necessarily be cases in which to attempt to remove a tooth with the animal standing would be simple folly and time lost, but with many operators in this country, we have in several instances succeeded in extracting a condemned molar without any other means of restraint than a twitch on the patient's lower lip or on his ear. The removal of molars is effected in two ways—by pulling, or by repulsion or gouging out.

The method by *extraction* or *evulsion*, is preferable whenever it is practicable, having the advantage of causing less injury to the surrounding structures, and is objectionable, principally for the posterior teeth, which always oppose great difficulties to the operation. The oldest instrument used in this operation is the enlarged key of Garangeot, as modified by Delamarre. Its application has always seemed to us difficult, if not dangerous, and we think that it involves more or less risk of fracture of the plates of the maxillary bone, on which account we prefer the large tooth forceps, which may be found under many forms and designs. The forceps of Plasse (Fig. 351), of Wendenburg (Fig. 353), of Pillwax (Fig. 354), of Gowing (Fig. 355), of the same inventor, as modified by Bouley (Fig. 356), those of Gunther (Fig. 358), the key-forceps of Bouley (Fig. 357), those of House, of Walters, and many others will furnish the operator a large collection from which to select. Many of these instruments are very complicated (as that of Scheffer); some are clumsy and difficult to handle; have levers, like those of Wendenburg and Pillwax; many work by merely grasping the tooth and holding it by a peculiar arrangement of spring, or of thread-screw, and thus to the end of the chapter.

We have for many years given the preference to the simple forceps of Gowing, leaving off the little rod which is connected with the cross-piece which carries the thread, and which is to be screwed on the handles of the instrument to hold them firmly together. What we think most essential in the instrument is that its arms should be firm and so solid as not to bend or yield when the screw is applied on them, and that the jaws of the forceps should not be too narrow nor too curved, and above all, that the instrument should not be made unnecessarily heavy, a fault which we have too often observed in some of the continental patterns.

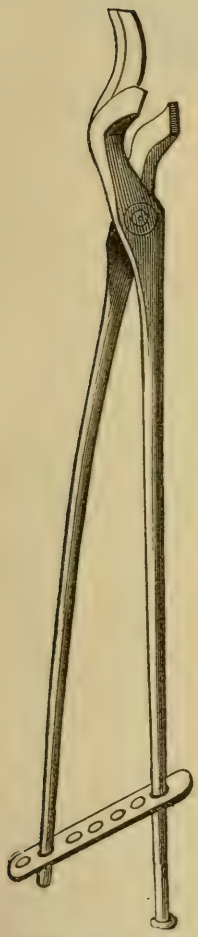


FIG 353.—Wendenburg Forceps.

FIG. 354.—Pillwax's Forceps.

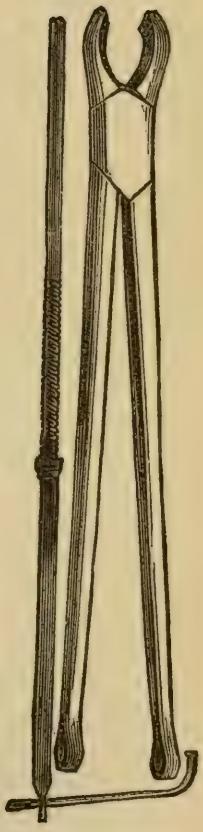


FIG. 355.—Gowing's Forceps.

Besides the forceps which we have named there are many others, but whatever may be their plan or shape, the manner of using them includes nearly the same manipulations for all. These, in their various steps, are done about as follows: the animal being properly secured, with his mouth open, and his tongue drawn

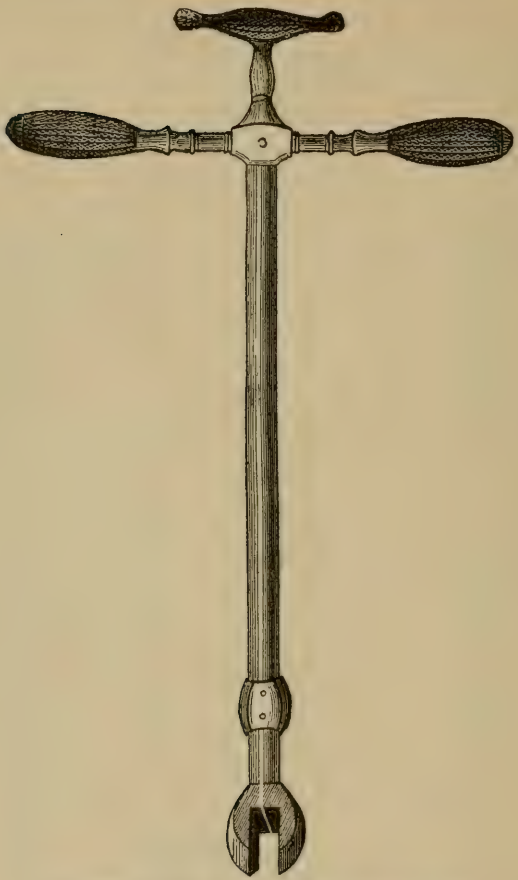


FIG. 356.—Gowing's Forceps, Modified by Bouley.

out on one side, an assistant inserts the forceps into the mouth, adjusting it to the tooth to be extracted, and notifies the operator of the moment when he can close the jaws of the instrument together, which is done in various ways according to the kind of instrument in use. When the tooth is properly seized and firmly held by the forceps, the operator, using all his force, carefully and slowly oscillates the instrument from left to right, and from right to left, in order to produce the gradual dislocation of the organ, and when it is loosened from its attachments it is drawn vertically out of its cavity by a final movement of evulsion. There are instruments possessing a lever attachment close to the

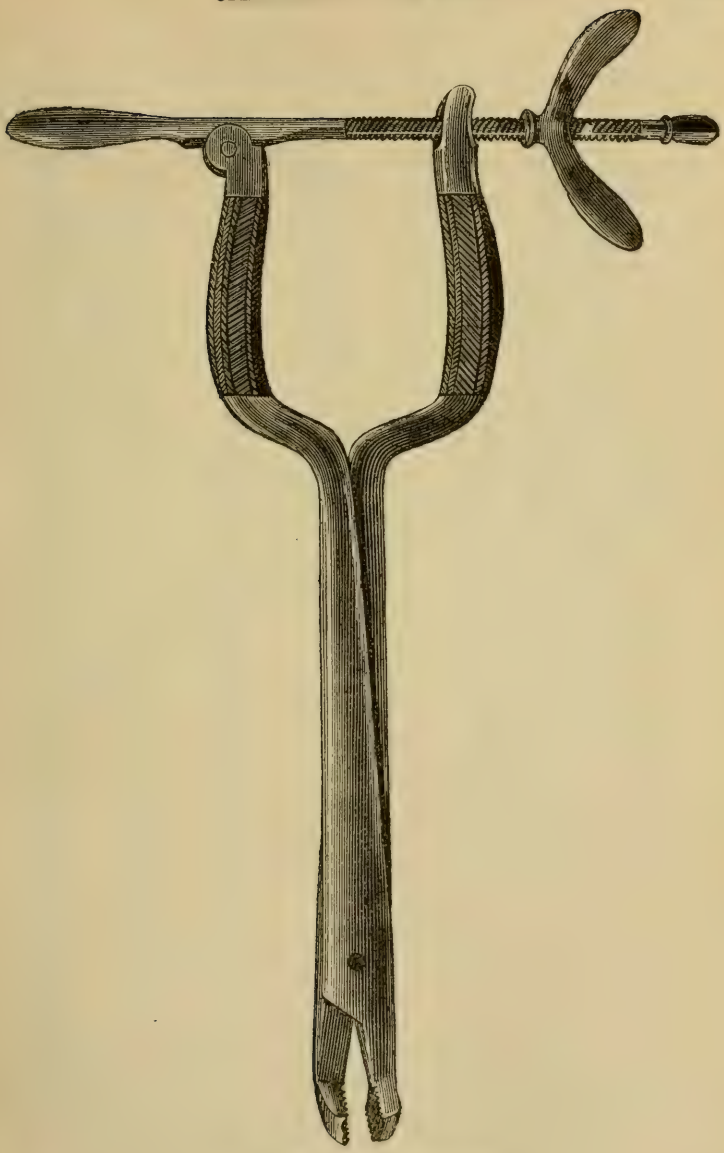


FIG. 357.—Bouley's Tooth Keys.

jaws by which the extraction of the tooth is considerably facilitated. If the animal has not been put under general anesthesia the dislocation of the tooth is very painful, and often accompanied by

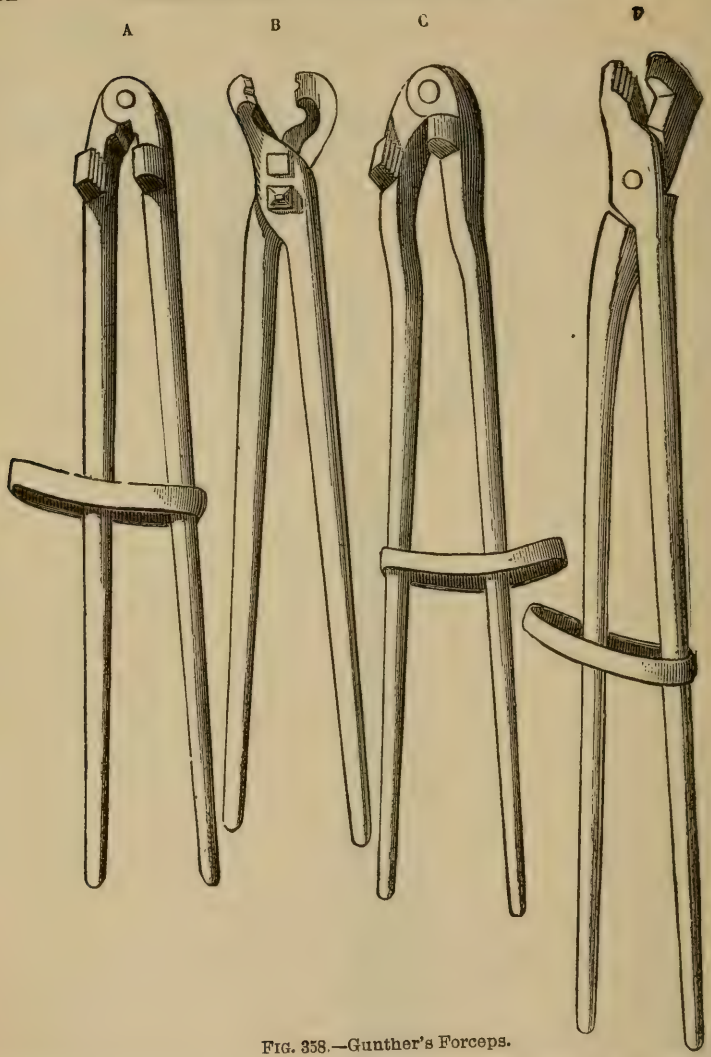


FIG. 358.—Gunther's Forceps.

violent struggles, at the critical moment; and if the tooth is not very strongly held by the forceps, it is possible that it may slip out of the jaws of the instrument and drop into the mouth. To avoid the possibility of its passing into the pharynx, we think it would be but a prudential measure to have an assistant keep his hand in the animal's mouth ready to secure the tooth, if necessary, before it passes beyond the soft palate.

The second mode of extracting molars, or that by *repulsion* or *gouging*, is the only one possible under all the circumstances, when the prehension of a carious or diseased tooth cannot be effected by the instrument used in the first method, as, for instance, in cases of disease of the posterior molars when the carious tooth is so far diseased or destroyed that not enough of its substance remains above the root to be reached by the forceps; or again, when the exostosis of the root has reached such dimensions that it will not allow its exit from the alveolar cavity, whatsoever efforts may be made to overcome its resistance.

This operation was first recommended by H. d'Arboval, and although it has been condemmed by some practitioners, is certainly indicated for all operations upon the molars. All the superior molars, together with the three anterior inferiors, are readily reached by their roots, in trephining the external plate of the bones in which they are implanted. The posterior inferiors are the only ones that present any serious objections, and the trouble is truly a tangible one, being nothing less than the necessity of passing through the entire thickness of the masseter muscle.

The tooth demanding removal being surely identified, and the impossibility of removing it by the mouth well established, the animal is thrown on the side opposite to that which is occupied by the diseased organ, and placed under complete anesthesia. The location of the alveolar walls, upon which the operation is to be made in order to reach the root of the tooth, must be first well determined. If it is one of the last three upper molars, it will correspond to the sinuses. But the operator must not allow himself to be deceived by the presence of a fistulous opening, which, by appearing on the surface of the skin to indicate the point of attack, may in fact mislead him by conducting him to a point considerably remote from the diseased tooth. A positive and satisfactory diagnosis being settled, and the hair being clipped, a large V or cross-shaped incision is made over the spot selected for the trephine, and carefully avoiding the infliction of any injury to the muscles of the region, the sinuses are opened by removing two or three circular portions, at a tangent to each other, to effect the removal of a fair-sized piece of the bone. The edges or prolongations which remain are levelled off with the bone forceps, which is certainly preferable to any other means; or if the opening made in the bone is too small, it can also be enlarged by using the same

bone forceps, by nipping off fragments from the edges and making entrance into the sinuses of the proper dimensions. The wound and the sinuses are then thoroughly cleaned out, and the blood and the pultaceous purulent collection found in their bottom thoroughly removed. This exposes the root of the tooth, in the form of a hard, dry, greyish mass, analagous to a piece of necrosed bone. The operator, then holding the *blunt gouge*, or *repoussoir* in his left hand, applies it through the sinuses against the middle of the dental root, and with a strong mallet held in his right, strikes upon it with firm and steady blows. The mouth of the animal being held open by the speculum, an assistant with his hand upon the crown of the tooth studies the effect of each blow, and notes as it yields to the percussion, and moves and loosens until it becomes detached, and falls, liberated into his hand, secured by his continuous grasp from any possible danger of being swallowed. As a rule the tooth is pushed out of its cavity by the first blows, either entire or in as many portions as it may have been divided into by the carious process. But at times it becomes necessary to repeat the percussion and to use considerable force to compel it to leave the jaw.

The *modus operandi* is about the same for any of the molars, though for the lower teeth greater force in the blows of the mallet is generally required, in consequence of the greater thickness of the walls of the alveolar cavities in the lower maxillary bone. If it is one of the posterior lower molars which is the subject of the operation, the masseter muscle must be cut through, but the general manipulations are otherwise the same, care being required, however, to avoid injury to the glosso-facial artery, or the duct of Steno.

Though apparently a severe operation, this is not a dangerous one, the wounds which it involves healing rapidly, and the great advantages which are realized by it, among which may be included the cleansing of the sinuses, and the removal of their suppurative collection, which could not be otherwise secured, amply compensating for the severity of the process.

After the operation the wound is, of course, to be thoroughly cleansed, fragments of bone to be removed, and acidulated gargles used to wash the mouth and the cavity of the alveola of its blood.

The cicatrization of the external wound generally gives no trouble to the surgeon, and requires no particular methods be-

yond those of ordinary cleanliness and proper attention to the granulating process. It is the cicatrization of the internal wound which requires attention, and in some cases a great deal of it. This is in order to guard against the collecting and the packing of the food in the cavity of the alveola, and thus interfering with its closing up by proper granulations. The diet of animals thus operated on must, of course, consist almost entirely of liquid food, as mashes of bran or of oatmeal; hay teas, flour water, milk, etc., or of cooked roots, scalded grains and the like. According to some authors, fibrinous food is dangerous only during the early days immediately following the operation, but our experience has taught us that neither solid nor semi-solid food is to be allowed to an animal which has lost a molar tooth, for a period of from three to four weeks, and during that time the alveolar cavity ought to be thoroughly cleansed out *after every meal*, until all possibility of danger has subsided.

The vacuum left in the dental arch after the removal of a tooth is never entirely filled up, but it gradually diminishes, in consequence of the oblique direction which the teeth in front and behind are disposed to assume, and which, though it brings them closer to each other, never brings them into actual contact. It may happen that by reason of this vacant space the tooth on the opposite side of the jaw may acquire a tendency to grow to excess, and from want of wear, ultimately project above the level of the other teeth. In reference to this it will be but prudent to watch the condition of that particular tooth, and to be prepared to reduce it to its proper level, if that should become necessary.

In reference to accidents that may occur during operations upon the teeth, we have already mentioned the possibility of deglutition of the tooth as it is drawn from its socket. In some cases reported by Renault and Bouley fatal results have followed, caused by violent colics thus induced. Strong cathartics have been recommended in these cases for the removal of the foreign body, but the precaution which we have already mentioned will effectually prevent the possibility of this accident. Bruises and excoriations of the bars, with the speculum, and hemorrhage, are accidents which also sometimes accompany these operations of extraction. The first is not usually a matter of any importance, unless necrosis of the jaw should follow; and as for the hemorrhage, unless it results from direct injury to the palatine artery, it is easily con-

trolled by pressure and packing with oakum or compressed sponges. Fractures of the alveola, or of the lower maxillary bone, are of a more serious character than any of the preceding injuries, the last, mentioned in a case recorded by Koerter, having necessitated the destruction of the animal.

Filing Teeth.

This operation has not, we believe, as yet entered into the general practice of veterinary surgery, and, with the exception of a few veterinarians on this continent who have attempted it, we think that in the presence of the many difficulties which exist in realizing a perfect result, similar to those obtained with the thorough work of human dentistry, it will be some time before this branch of veterinary dentistry can be practiced with any great prospect of good and permanent results. Our experience in filing the teeth of our domestic animals is very limited, and on that account we will refrain from saying more about it, referring our readers to the work of Dr. Hinebauch on "Veterinary Dental Surgery," where the subject is treated rather extensively.

Canine Dentistry.

Operations on the teeth of the dog are sometimes indicated under some peculiar and abnormal conditions, such as irregularity in number or in direction, or in cases of traumatism, such as fractures or dislocations. Their extraction is performed with tooth forceps, as we have already had occasion to remark. Their *resection* has been recommended by a French veterinarian, Mr. Bourrel, as a means of preventing rabid inoculation (Fig. 359). The operation is a very simple one, and consists in smoothing over the sharp points of the teeth with a file, though sometimes sharp nippers are used in preference.

But an operation which is of daily necessity is that of *cleaning the teeth* by removal of the accumulation of cement or tartar, which gathers on the external surface of the tooth, at its insertion in the alveolar cavity, where it forms a thick crust, of greenish gray color, composed of microscopic fungi. In neglected cases, the gums become irritated and ulcerated, and the tooth, partially denuded of its gum, exposes not only its free portion, but portions of the root also, sometimes even becoming loose and dropping out of the jaw. There is in these cases a free and abundant

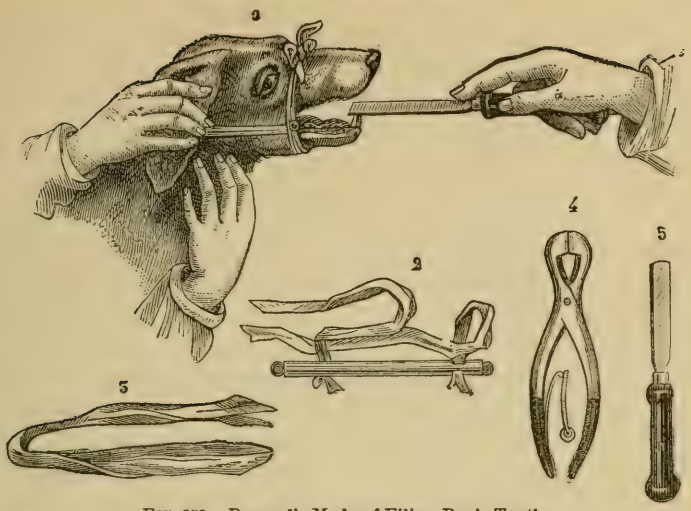


FIG. 359.—Bourrel's Mode of Filing Dog's Teeth.

flow of saliva, of a characteristic and putrid smell; mastication becomes impossible, and the animal becomes a regular martyr to the lack of attention of his dental apparatus. The formation of these concretions can be prevented in animals in the same way and with the same care that is exercised in respect to the human when teeth-washing, brushing, etc., with some of the properly compounded tooth powders, will remove a slight coat of the offensive deposit, but if the accumulation is quite large, it must be scraped off with proper instruments (Fig. 360), carefully avoiding, if practicable, any injury to the gums, or the loosening of the teeth.

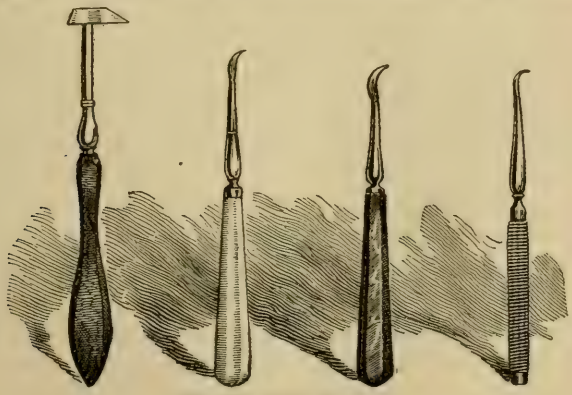


FIG. 360.—Tooth Scrapers.

If several teeth are loose, and their loss is threatened, the better course in regard to their extraction will be to remove them singly, and not all at the same time, lest a serious hemorrhage might supervene, which might even endanger the animal's life.

OPERATIONS ON THE TONGUE.

The pathological lesions to which this member of the digestive apparatus is subject, and which may require surgical interference, are principally wounds and tumors, the former demanding either sutures or amputations of the organ, partial or complete. The latter, however, present a greater variety of indications, according to the nature of the neoplasm with which the organ may be affected. Wounds of the tongue are quite frequent, but the most common are probably those of the lacerated kind, though again, they may be the result of contusion, incision, or may even be caused by burns.

Produced generally by self-inflicted bites, caused by falling, or during epileptic seizures, they are usually made by the incisors. A badly made bit, or a halter or rope tightly binding the mouth and pressing down the tongue, may also produce a bruise, or even a complete laceration of the organ. They are also not uncommonly seen as the result of bites inflicted by one animal upon another, placed in an adjoining stall, when the separation between them has been insufficient. In these cases, not only a portion of the tongue, but often also the frænum may be more or less lacerated—a condition which may also take place when the tongue has been pulled out by an assistant, a groom or other person, and the horse rebelling, pulls back violently and suddenly. Against such opposite forces the soft structure of the frænum readily gives away. The burnt wound, or scalding of the tongue, may arise from the administration of a drench not sufficiently cooled, or of too irritating a nature. The common way of steaming horses with bran heated with boiling water, is also an occasional cause.

Injuries such as these are generally easily detected, presenting, as they do, a series of symptoms which may properly be called general. Difficulty in eating, and a more or less abundant flow of stringy saliva, which also may be mixed with blood, is apt to be among the signs. In relation to the special characters, noticeably, there may be in one case a protrusion of the

tongue out of the mouth, with perhaps a drawing of the organ to one side, or it may be pressed between the incisors and hanging more or less outside of the buccal cavity. In opening this cavity, the tongue may then be seen to be lacerated at its free portion, the laceration being transversal or longitudinal, complete or incomplete, and varying in dimensions, from a small portion of the organ nipped from the main body, to nearly the entire portion in front of the frænum. If the anterior portion is missing, the frænum may be seen in its normal condition, or again may be extensively torn, in which case the tongue is commonly hanging out of the mouth. If the laceration is complete, the part in front of the cut may have dropped outside and fallen into the bedding of the animal, or of the one next to him, both stalls being more or less spattered with blood from the hemorrhage which has accompanied the injury.

In cases of burns, the tongue presents all the symptoms of glossitis, it is swollen, its epithelium readily peels off, the salivation is abundant, and the mouth heated and sore.

Considered from one point of view, the prognosis of lacerated wounds of the tongue is not serious, there being but few forms of that injury which are not more or less amenable to treatment. The nature of the prognosis varies, of course, with the extent of the wound, the depth of the tissue which it involves, and the amount of substance already lost or requiring removal. A complete section is always a serious matter, especially in herbivorous animals, by which the tongue is so largely employed, and so efficient, as an instrument for the prehension of food, as well as for aiding in its mastication, by keeping it in contact with the grinders during the process of chewing.

In carnivorous animals, as in dogs, we have seen the complete sloughing of the free portion attended with such difficulty in eating, that the destruction of the patient became necessary in order to avert his death by starvation.

In almost all conditions of laceration of the free portion of the tongue, there is an indication of an attempt to effect the union of the divided parts, and our experience has led us to the conclusion that no one is justified in refusing to treat a wound of the tongue or abandoning such a case without at least an effort to save it, even, as in some cases, where the divided parts are held together by the smallest portion of substance.

Suture.

It is only by suture that the attempt can be successfully made. Peuch, Toussaint and Zundel advise the throwing of the horse, but we prefer the standing position for the operation. The instruments necessary are strong needles for metallic sutures, and soft, pliable lead wire. We prefer this kind of suture as being less liable to cut through the muscular structure of the organ and having less tendency to give way. Having carefully washed the surfaces of the lingual wound, we apply an interrupted suture, varying the number of stitches, according to the extent of the laceration, and prefer the interrupted to the continued suture for the reason that if one stitch fails to hold, it can be easily replaced by another. The important point is to secure a thorough hold for each stitch, or in other words, to involve a good portion of the tongue in the stitch on each edge of the wound.

Wounds of the frænum need no special treatment, but there is an indication which by its application greatly facilitates, though indirectly, the cicatrizing process of the two parts. It consists in placing the tongue in a muslin suspensory, having the shape of the free portion of the tongue, and sewed together on a part of their circumference, leaving an opening for the organ to enter. This suspensory is kept in place by two strings attached to the halter on each side of the cheeks. The use of this easily made appliance has given us great satisfaction, not only in keeping the tongue in the mouth, but also in limiting the movements of the organ, and preventing the giving way of stitches. The suspensory is to be taken off two or three times a day, and washed, or changed for another, but must be kept in place as long as this condition of the patient requires it. The mouth is to be kept clean by antiseptic astringents and cooling gargles, by means of a syringe or an irrigator. The use of peroxide of hydrogen has given us excellent results in these cases. Nocard recommends the application of a muzzle upon the patient's nose, to prevent the prehension of fibrous food, keeping the mouth closed, and restricting the movements of

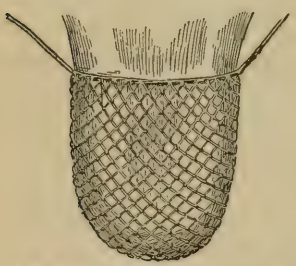


Fig. 361.—Tongue Suspensory.

the jaws. During the treatment the animal is to be fed with liquid or semi-liquid food, as mashes and gruels of all kinds, with teas, milk, etc. It is only when the stitches are all united that the animal can be brought by degrees to its ordinary diet. After several days the sutures can be removed.

Amputation, or Glossotomy.

When the sutures have failed, or when the peduncle which holds the divided portions of the tongue together is too small to permit the processes of circulation and nutrition to go on, the indications are to amputate the part of the tongue below it. This is done with the scissors; the hemorrhage that may follow is seldom serious, and soon ceases spontaneously, or yields to the use of hemostatics. Sometimes, instead of direct amputation, or in order to avoid the hemorrhage, the removal of the divided portion is effected with an elastic ligature—a mode of treatment also commonly used for the removal of lingual tumors. The ecraseur has also been recommended, on account of the absence of hemorrhage attending its use. The animal whose tongue has been amputated eats slowly and with difficulty. His prehension of liquids is also necessarily interfered with. It requires time and practice for him to acquire facility in performing the old functions with curtailed means.

Adenotomy.

This operation consists in the dissection and removal of such of the glands as are accessible and amenable to that method of treatment, including the lymphatic and salivary, and is described as parotidian or maxillary, as one gland or the other becomes the subject of operation. The extirpation of these organs is indicated by pathological changes occurring in their structure, as in cases of chronic infiltration following a suppurative process, as seen in the lymphatic glands of the inter-maxillary space after strangles, and again when they become the seat of scirrous degeneration, or of melanotic deposits, or in cases of salivary fistula complicated with loss of substance of the excretory ducts.

Parotidian adenotomy is a very delicate operation, and has, therefore, been but seldom attempted. To Leblanc, in 1822, is due the record of its first performance, and of the advantages attending it. A reference to Figures 396 and 397, which show

both the superficial and the deep anatomical structures of that region, will at once suggest the difficulties to be encountered in the numerous and important blood vessels, which must be either avoided or ligatured, and the important nerves which must be saved According to Brogniez, the operation is fully justified by its results, and possesses an undeniable claim to admission into the domain of authorized veterinary surgery. After Leblanc, it was performed by Brogniez, Vanhaelst, Delwart, Barlow and Percivall.

The *Traité de Chirurgie Vétérinaire* furnishes the following description of the manual execution of parotid adenotomy: "The animal, being well prepared, is thrown, with the parotid region of the side on which he lies resting on a small bundle of straw, in order to render the gland, which is to be operated upon, more prominent, and the hair being clipped, a long incision is made in the direction of the organ, viz., from the anterior part of the base of the ear down to below the glosso-facial branch of the jugular vein. This first incision, it may be remarked, must be made more to the anterior border of the gland, which is strongly adherent to the maxillary bone, as well as to the blood vessels and nerves passing that point, and, if necessary, a second incision can be made behind the first and perpendicular to its lower extremity. The skin being dissected from the whole extent of the gland, the beginning of the separation of the organ is made near the facial nerve, from thence gradually working downward. The lower extremity of the gland is isolated, and after it the posterior border, to terminate by the superior extremity, which surrounds the concha—in other words, without reference to the muscular layer that covers it, or to some little glandular masses which are isolated from the principal mass, nor even to its central portion situated under the facial branch of the jugular vein; the gland being thus separated is removed in its whole circumference. After ligating the blood vessels which may have been opened, the wound is dressed and closed with quill sutures. Suppuration is soon established, the granulations rapidly develop themselves, and the cicatrization is soon accomplished."

The most serious complication usually met with is the section of the facial and sub-zygomatic nerves, which is followed by paralysis of the face and lips on that side. Director Degives divides the operation into three steps. *The first* includes the *incision*

and *dissection of the skin.* The incision is made lengthwise, from the base of the ear down to the middle of the external face of the gland, that is, as far as below the glosso-facial vein, and involving the skin and the parotido-auricularis muscle, the dissection of the skin being made a little beyond the borders and extremities of the skin. The *dissection of the gland* forms the second step, and must be as complete as possible. There are some parts where the gland is difficult to isolate, especially at the base of the ear, at its masseterine adhesions near the sub-zygomatic blood vessels and nerves, but at these points some little glandular granulations may be left. In this dissection the use of the fingers or of the dull end of the handle of a dissecting scalpel is recommended in order to avoid the blood vessels and nerves which are so intimately connected with the organ.

Beginning with the ligation and section of the posterior auricular vein, the anterior border of the gland is isolated from above downward, carefully avoiding the sub-zygomatic blood vessels and nerves, after which the jugular vein is isolated in the whole extent of its parotid course, and the gland divided into two portions, one above, the other below the vein. The dissection of the upper portion is made from below upward, avoiding *first*, four arterial divisions, including the external carotid, the temporal trunk, the internal maxillary, and the posterior auricular; *second*, the superficial temporal and the facial nerves; and *third*, the guttural pouch, which is intimately adherent to the internal face of the gland above. The smaller arterial branches that are divided are ligated or twisted. The lower portion is then carefully dissected from above downward. The *dressing of the wound*, which is the third step, is performed according to the process of Brogniez.

Maxillary Adenotomy.

We find but a single description of this operation, which is by Director Degives in his *Manuel de Medécine Opératoire Vétérinaire.* Recommending it only as the last treatment in the refractory fistula of Warthon's duct, he first divides the skin and the cutaneous muscle against the inferior border of the gland, parallel to the glosso-facial vein, and makes an incision about four inches long, which brings him to the loose and abundant cellular tissue which surrounds the gland. The dissection is made with

the fingers by tearing the connective tissue in the middle part of the gland; when taking hold of it at that place it can be carefully pulled out, the division of the cellular tissue which holds it being easily detached with the fingers or a blunt instrument. The position of the wound is such that no special dressing is indicated, suppuration having a free exit.

OPERATIONS ON THE ŒSOPHAGUS.

The surgical affections which require interference with the œsophagus and adjacent regions are classified as follows: Bruises, wounds, lacerations, ruptures, tumors, jabot, obstruction by foreign bodies or alimentary masses, and strictures. The various operations of direct application which are indicated in connection with these casualties are: Catheterism of the œsophagus, the taxis, the crushing of the foreign bodies, and œsophagotomy. This classification, arranged by Peuch and Toussaint, meets with our acceptance, including the operations enumerated, and in our consideration of the subject we shall, for the present, refer our readers for descriptions of the various forms of disease to the standard authorities upon veterinary medicine, especially including in the list the excellent work of Professor Williams.

Before entering upon a description of these operations, a review of the surgical anatomy of that organ will be in place.

The œsophagus is a long musculo-mucous canal, which at the third step of deglutition carries the food, both liquid and solid, from the pharynx to the stomach. Stretched between these two organs, it successively occupies the neck down its inferior region, the entire length of the thorax, and a small portion of the abdomen. At its origin (Fig. 362), situated on the median line, it communicates with the pharynx by an opening above the glottis; from thence it runs obliquely downward, from before backward, behind the trachea, until about the middle of the neck, where it begins to deviate to the left, resting from thence on that side of the trachea. In this situation it enters the thorax, to resume its former position on the trachea; passes above its bifurcation and the base of the heart, running through the layers of the posterior mediastinum, which covers it, reaches the right pillar of the diaphragm, and passes through it, and entering the abdomen, has its termination on the left side of the small curvature of the stomach.

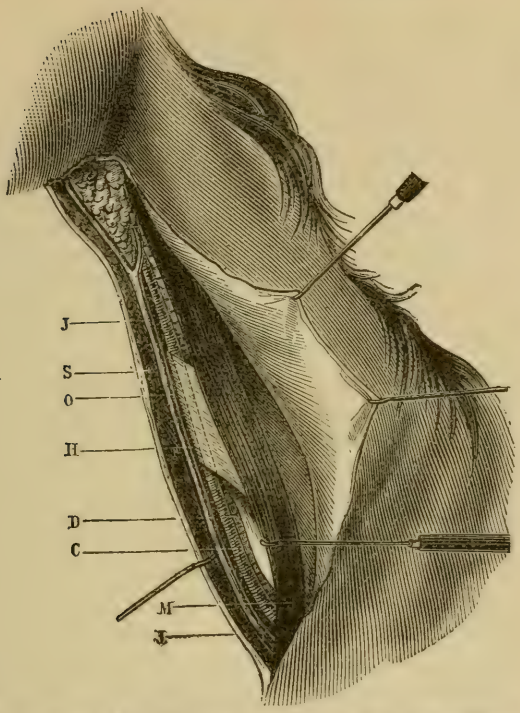


FIG. 362.—Anatomy of the Œsophagus and Jugular Vein of the Horse. J J, jugular vein; C, carotid artery; O H, sub-scapulo hyoideus muscle; D, œsophagus; S, sterno-maxillaris muscle; M, mastoido-humeralis muscle.

The relations of the œsophagus must then be considered according to its divisions of the cervical, thoracic and abdominal portion. At its point of origin, at the pharynx, it is situated between the larynx and the guttural pouches. In the upper half of the neck it is in relation, in front, with the trachea; behind, with the long muscle of the neck; and on the side with the car tid and its satellite nerves. Below this point, and as it deviates to the left, it is related to the left side of the trachea, upon which it rests, and on its outside, with the scalenus muscle, the carotid artery and the jugular vein. In a very few instances, instead of passing to the left of the trachea, it deviates to the right, but otherwise holds the same relations as when in its normal position. At its entrance into the thorax, the œsophagus, still on the side of the trachea, corresponds outwardly with the inferior cervical ganglion and its branches, and to the vertebral, superior cervical and dorsal arteries

and veins, which cross its course and further back, returning between the trachea and the longus colli, it passes over the left bronchia and to the right of the thoracic aorta. Beyond this, placed between the folds of the posterior mediastinum, it is received into the groove of the internal face of the lungs, with the œsophageal arteries and nerves. Passing through the opening of the right pillar of the diaphragm, we find it in its abdominal portion related on the right to a notch of the superior border of the liver, and ending at the cardiac. The structure of the œsophagus is formed of two coats; one of external and muscular, the other of internal and mucous membrane. The external is composed of muscular fibers, spiral, red and longitudinal, striated in its anterior three quarters, and white in the posterior quarter. Anteriorly, the crico-pharyngeus furnishes it with a sort of circular necktie. Towards its posterior portion, the muscular coat is much thicker than in the other parts, and as it passes through the pillars of the diaphragm, it is more or less pressed upon. These three points must be remembered, inasmuch as they serve to explain the resistance which is encountered by instruments, such as the catheter, or the probang, when introduced into its cavity. The internal coat or mucous membrane is whitish, with longitudinal folds, which are so developed at the cardia that they may resist the passage of the probang into the stomach.

Œsophageal Catheterism

is an operation consisting in the introduction of a special instrument, solid or hollow, but always flexible, into the cavity of the œsophagus, either to remove bodies that obstruct it, or to aid the exit of gases which have accumulated in the stomach.

It is therefore indicated in three principal conditions, viz.: first, *tympanitis* in ruminants; second, in cases of *œsophageal dilatation*, or *jabot;* and third, to dislodge foreign bodies arrested in its canal.

In cases of *tympanitis*, it is of advantage if the trouble is not too far developed, and danger of suffocation not too imminent. In cases of *œsophageal jabot*, due to a more or less extensive dilatation of the organ, in consequence of the lodgment and packing of food, it is in many instances of but very little benefit. When foreign bodies are lodged in the œsophagus, an accident to which horses are liable, and which is very common in cattle

and in dogs, it is often of great advantage. The operation would naturally depend very largely for its success upon the size of the foreign body, which of course is a variable circumstance, and also on the condition of its external surface, whether rough or smooth, or having projecting points; depending much likewise on the situation in the length of the canal, and whether it has become engaged in the cervical or the thoracic portion of the passage.

Probangs for the throat and a speculum for the mouth are instruments necessary for this operation.

There are various forms of probangs, the designs of different inventors. The first, which, according to Brogniez, was invented by Monro of Edinburgh, has been more or less perfected. The probang of Baujin (Figure 363) is reversible, and may be so adjusted as to either push down or extract the offending substance from its place of lodgment. The instrument in ordinary use is designed essentially to push the obstruction through the passage. It is found in all our surgical instrument makers' shops, and is made of whalebone or of rubber, separable in two parts, connected by a screw. One end (Fig. 364) has a bulbous enlargement, the other a blunt mass or head, made concave

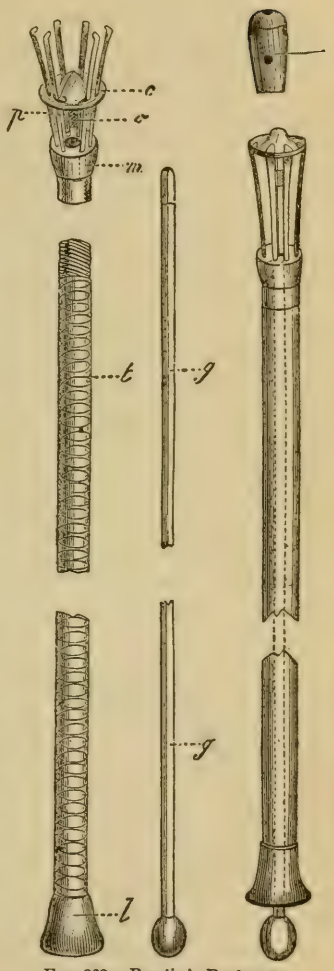


FIG. 363.—Baujin's Probang.

FIG. 364.—Ordinary Whalebone Probang.

on its free end, the better to act without slipping against the object with which it is to come in contact. The probang of the stomach pump forms an excellent instrument for that purpose.

Dr. Peabody has constructed a simple implement of strong, thick wire, twisted together and forming a rod of sufficient length, protected by a tube of India rubber, and having one end formed into a ring or loop, to serve as a handle, while at the other extremity a sponge of suitable size is secured and formed into a bulb resembling that of the ordinary probang. Degives recommends for use in cases of emergency an extemporized instrument, formed of a whip handle or a branch of a tree, of sufficient length, of the size of the little finger, with a bulb composed of a ball of oakum covered with cloth. This bulb is attached to the end with strong twine, of which a free end is left of equal length with the instrument, in order to draw out the broken fragments in case of fracture of the probang.

Whatever form of probang may be used, it is always necessary to associate with it a speculum to keep the mouth sufficiently open and immobile. Those which are recommended and em-

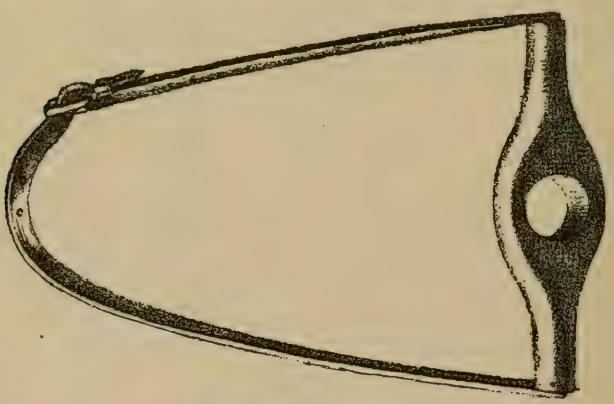


FIG. 365.—Brogniez's Gag.

ployed in the exploration of the mouth are available for this purpose. But as these are not always obtainable, some ingenious and simple apparatus can be made at a moment's notice like that illustrated in Figure 365, which, or something equivalent, ought to be within the scope of the inventive and constructive capacity of any well equipped surgeon.

In ruminants the operation is performed in the standing position, with the head extended and elevated on the neck. In solipeds it cannot be performed except while the animal is down, and when the head can be placed in the proper position of extension to allow the instrument to pass beyond the elbow formed by the pharynx and the œsophagus. The animal being in position, and the speculum adjusted, an assistant draws the tongue out of the mouth, and the operator, placed in front of his patient, passes the probang through the opening of the speculum, and rapidly pushes it into the mouth, resting it upon the hard palate, in order to prevent its being displaced laterally by the motion of the tongue. At the bottom of the mouth the probang meets with some little resistance at the soft palate, but the instrument soon reaches the fauces, in the pharynx, and penetrates the œsophagus. At this moment possibly some resistance may be encountered, owing to the contraction of the crico-pharyngeus muscle, but once engaged in the œsophagus the instrument readily passes the proper distance downwards, according to the requirements of the case. If the object in view is to relieve tympanitis, and a true catheter, tube, or stomach pump or hollow probang has been used, the gases will find a means of exit as soon as the instrument has penetrated the stomach.

If the catheterism has been performed for the displacement of foreign bodies, the resistance they offer to the pressure of the probang must be overcome by a steady, and, at times, quite a powerful pressure of the instrument, caution being always necessary to avoid causing laceration of the wall of the passage. When the obstruction is even but slightly loosened, its complete dislodgment often follows from the mere unassisted contraction of the œsophageal muscles. Caution and gentleness must not be overlooked even in the mere withdrawal of the probang. It should be practiced as a maxim, indeed, that whatever instrument may be, for any purpose, made use of, not alone in the propulsion of the intruding body in these cases, the operator must never remit his caution and gentleness, nor lose sight of the fact of the natural liability to accident always accompanying surgical interference with the organs and tissues having their place in the interior regions of the animal organism, and not cognizable by the eye. Serious accidents have been recorded as resulting from a lack of care and attention in the manner of withdrawing the in-

strument. Lacerations of the œsophageal walls, rupture of blood vessels, perforation of the trachea, abscesses of the mediastines, pleurisy and pericarditis belong to the list of recorded casualties in this connection. To facilitate the working of the probang, in these cases, certain practitioners have recommended the administration of oil or mucilaginous drenches.

The Taxis.

The œsophageal catheterism which we have just considered is principally applicable to cases where the obstruction is in the thoracic portion of the passage. When it is in the cervical portion, instead of *propulsion* or *intrapulsion*, it is by *extrapulsion*, or by the course of the natural passages that the foreign body is to be removed. In this case the taxis is made to take the place of the ordinary artificial appliances, and the hands become the instruments with which the surgeon seeks, by making forcible and methodical pressure, to move the impacted object back into the mouth.

In 1820, Delafoy recommended a process which is to-day admitted to be one of the best modes of relieving cattle when suffering with this difficulty, and many other methods have since then been devised, but most of them are merely modified plans of Delafoy's method. We shall consider them as briefly as possible. In order to raise the *impact* (as we shall for convenience call it) back into the pharynx, Delafoy has the animal thrown, on the right side, and administers a glass of sweet olive oil, and while an assistant steadies the œsophagus, applies with his fingers upon the impact, a retrograde motion which carries it upward, back and to the pharynx. When it reaches that cavity, the head is raised, the jaws are opened with a speculum, and the operator, passing his hand through that instrument into the back of the mouth, seizes the impact and brings it away. Lindenberg keeps the patient on his feet instead of casting him, but otherwise observes the same *modus operandi*. Denenbourg operates with his patient in a standing position. While an assistant holds the head, well extended, and elevated on the neck, he places himself on the right side of the animal, and with the fingers pressing below the impact (like Delafoy), displaces it and gives it the ascending motion which transfers it to the pharynx, and keeps it there by pressing hard below it. Then putting an assistant in his

place he proceeds like the others to remove the impact with the hand passed through the speculum.

Schaack operates also in the standing position, the hind legs being hobbled above the hocks, the head is kept, as much as possible, in a horizontal position, and a speculum placed in the mouth. The operator takes his place on the left side, in front of the shoulder, the right hand on one side of the neck, the left on the other. If the impact is rather low down, or near the chest, the extremities of the fingers are brought together and employed to push it upward, with careful manipulations. If it is situated higher up, near the œsophagus where it is less surrounded by muscles, the pressure is made with the fingers closed. In either case, however, when it has reached the throat, Schaack holds it there, while an assistant with his hand boldly introduced into the mouth, seizes it and draws it out of the pharynx.

According to Peuch and Toussaint, Mr. G. Tisserand, in cases of jabot, operates as follows: Making a point of support on the neck with the right hand, with the left he violently shakes the part where the projection of the jabot is most prominent, and then applies alternate movements, up and down, with a lateral shaking of the enlargement until the patient voluntarily lowers his head, and as he snuffles throws out through the nostrils and the mouth, abundant mucosities, mixed with alimentary detritus. If the first manipulations fail, Tisserand advises the occasional administration of mucilaginous decoctions, or oil, or even plain water.

The method of Martin is one which is also held in high esteem, and at the hazard of needless repetition and unnecessary minutiæ we give it in detail. Instead of extending the head, which has a tendency to stretch the œsophagus and diminish its diameter, he keeps the head of the patient low down, at about a foot from the ground, and placing himself on the left side of the neck, he passes his right arm over the neck, in such a manner that enveloping the neck between both arms, his hands can join on the lower border of the neck, and both thumbs pressed in the jugular grooves, one on the right, the other on the left. It is by successive pressures from behind forward, that he succeeds in pushing the impact in the pharynx. Then comes a peculiar step of the operation: As by its presence the soft palate closes somewhat the posterior opening of the mouth, the impact cannot re-enter this cavity, and thus, while the mass is in the pharynx and resting on

the posterior face of the velum palati, with both thumbs he pushes it from above downward and from behind forward; the effect of this is to depress the base of the tongue, and to enlarge the isthmus of the throat sufficiently for the impact to pass through it, back in the mouth, and drop it to the ground. If, however, the pressure required in this step of the operation could not, for one reason or another, such as excessive thickness of the lower border of the neck, for instance, be maintained, then the impact is extracted with the hand.

Courioux has advised the application of a cord around the neck, below the impact to be moved upwards with it, as the displacement is accomplished. The object of this is to retain whatever progress may be gained by preventing the mass from receding again. It forms a substitute for the fingers in holding it in position.

The extraction by the mouth of many substances arrested in the œsophagus has also been effected with instruments. Forceps long and curved, hooks and hollow sounds, having metallic nippers or jaws, like that of Baujin, have been recommended. That of Wegerer is probably entitled to the highest commendation of all. But with all their ingenuity and perfection their use is not without danger of causing lacerations of the œsophageal walls, and they are constantly liable to get out of order.

Crushing the Foreign Body.

At times the obstruction takes place in the cervical portion of the œsophagus, and attempts to displace it, either toward the mouth or the stomach, have failed. To meet this emergency various means have been sought for, either to crush the impact, or cut it in small pieces. One suggestion for the first object is to break it with blows of a mallet, a piece of wood, or other object held by an assistant, furnishing the point of resistance. But this is obviously a dangerous process, nearly certain to produce bruises and lacerations of the soft structures, with probably subsequent gangrene. At best it can be available only when the impact is in the form of a comparatively soft mass, such as ripe fruit or the like.

Professor Lafosse had in 1846 suggested subcutaneous incision, and this was put in practice in 1855 by Chapard for the relief of a cow choked by a piece of a beet. A simple puncture of the

œsophagus was first made, with a straight tenotome, below the obstruction, then a curved tenotome was introduced through the wound, and by careful movements in the mass of impact, it was sufficiently divided to enable it to resume its usual course downward into the rumen. Though this mode of operation has not become established in general practice, the application of its principle has not been overlooked, and has not been without its influence in simplifying the performance of the operation of œsophagotomy.

Œsophagotomy.

When the obstruction is in the cervical portion of the œsophagus, and, either because of its nature or of its form, cannot be displaced by any of the means we have discussed, the division of the organ itself furnishes the only escape from the consequences of the difficulty. The operation of œsophagotomy consists in the exposure of the œsophagus and the incision of its walls. While it is usually performed for the removal of obstructing bodies, it is also indicated in some cases as a mode of facilitating the administration of drugs, or, under special circumstances, of food and drinks.

It is of French origin, and its adoption in veterinary surgery seems to have occurred in 1782, when it was performed by Lompagieu Lapole to remove an orange, arrested in the inferior region of the neck. Since that epoch it has been performed on horses, cattle, dogs, and even on swine. Damoiseau, Felix, Michel and others have performed it on cattle; Thissine, H. Bouley, Reynal, Rey, Marrel, Mauri on the horse; Peuch, Macgillivray, Williams, on dogs, and Lagrange on pigs. H. Bouley performed it to remove a piece of corncob and a large molar tooth which, after extraction, had slipped into the œsophagus; Baldwin extracted a large piece of a root; Rey removed a cork; Peuch took away pieces of bone from a dog. In fact, the operation has generally, if not exclusively, as is but natural, been appropriated to the relief of patients laboring under the difficulty we have been discussing. A claim has been made in its behalf as a means of relief in lockjaw, by facilitating the artificial feeding of the sufferer. But such a claim, as to any practical value which may be supposed to attach to it, cannot in anywise possess any validity, nor be to any extent sustained when we take into consideration the history and the

nature of tetanus and its origin, with the complications and consequences likely to accompany and to follow it. Marrel has recommended it in cases of fractures of the jaws; but such practice would truly furnish an example of the proverbial case in which the remedy is worse than the disease. It has also been recommended for the relief of jabot, and has been, in some cases, followed by favorable results.

The instruments necessary for this operation are a convex and a straight bistoury, a pair of dissecting forceps, a director, a needle and strong thread; to these may be added a pair of scissors and two blunt tenaculums, with also large forceps to grasp the impact and extract it, close at hand. The animal must be kept in the standing position, and held under thorough control by an assistant, with a twitch on the lower lip or on the ear, and either fore foot raised or both fore legs hobbled.

It must be taken into consideration that the cervical portion of the œsophagus is situated immediately behind the trachea, continuing thence as far as the middle of the neck, when it deviates to the left, where it occupies the lower third of the neck; and again, that this cervical region is surrounded by an abundance of loose connective tissue, having on each side the carotid and its nerves. It will also be observed that the lower third of the neck forms a triangular space, with above it the inferior border of the sub-scapulo-hyoideus muscle, and on the sides the sterno-maxillaris, levator-humeri and scalenus. In this space it is in connection on the inside with the trachea, upon which it rests; and on the outside with the scalenus, the carotid, the jugular and the nerves of that region—organs which are all covered by the cutaneous colli and the skin.

The point of separation of the middle and lower third of the neck, in the left jugular groove, is the *place* of *election* or of *necessity* for the operation, or where the incision of the skin must begin, a little above and behind the jugular. If the obstruction is considerably prominent, this incision must be made directly over it.

Peuch and Toussaint, in their excellent work, divide the operation into three steps, which they thus describe:—

1st. Step. *Incision of the skin and dissection of the subjacent tissues.*—Standing on the left side, the operator first determining the situation of the jugular vein, clips the hair from over

the tumor, stretches the skin with the left thumb and index finger, and with the convex bistoury, extends the incision from the initial point, about four fingers' breadth down, parallel with the blood vessels. The incision divides the skin, and the cutaneous muscle, and exposes the jugular and carotid and their nerves. The thumb of the left hand is then introduced into the incision and depresses forward the blood vessels and nerves, while the other fingers of the same hand are embracing the tracheal border of the neck. The œsophagus is thus exposed on the lateral border of the trachea, and the cellular tissue which covers the organ is then divided. By raising the upper lip of the incision with a blunt tenaculum the œsophagus may be still more exposed.

2d Step. *Loosening or isolation of the œsophagus*—Cutting away part of the cellular tissue, the œsophagus is seized with the thumb and index of the right hand and drawn outward. The vasculo-nervous fasciculus are then let loose, the œsophagus is

FIG. 366.—The Œsophagus Drawn Outward and Raised with the Scissors.

drawn out with the left hand, the right holding the curved scissors, which being passed from above downward, and separating the remaining portion of cellular tissue, holds the organ resting upon its blades, in readiness for the third step (Fig. 366).

3d Step, or *Incision of the œsophagus.*—The operator then, supporting the scissors with the œsophagus resting upon them, in the left hand, with a straight bistoury with the edge turned upward, in the right, makes a large puncture in the œsophageal walls, passing through their entire thickness, and afterwards enlarging it with the aid of a director. At this point of the operation, and at each deglutition, there is usually an escape of mucosities mingled with food. When the impact forms a decided projection, the incision should be made directly over the prominence.

Professor Nocard has modified the operation in cases where the obstruction can be divided in small pieces, by making only a correspondingly small incision. He uses both a straight and a curved tenotome, and performs the first and second steps as in the preceding methods, the third one being made as follows: "The œsophagus being exposed, isolated and placed over the scissors, the operator introduces the straight tenotome through the œsophageal membranes, the blade running parallel with the muscular fibers, into the thickness of the impact (apple, potatoe, pieces of beet, etc.,) avoiding injury to the opposite surface of the canal; then sliding the curved tenotome against the straight one, and pushing it through the entire mass until it touches the opposite wall of the œsophagus, he withdraws the straight instrument, and divides the impact by movements of the curved instrument, analogous to those made in the division of the tendons in the operation of plantar tenotomy. The blunt end of the curved tenotome protects the œsophagus from any enlargement of the original wound."

Cagny, after exposing the œsophagus, as already described, crushes the obstruction by repeated gentle blows of a small mallet, as before described. He prefers this mode to that of incision if the impact, though hard and flat, possesses but little force of adhesion. When the objects of the œsophagotomy have been realized, there is no necessity for further interference, the application of sutures being generally considered rather injurious than otherwise, and though the resulting wound is of a somewhat complicated nature, its perfect cicatrization in a comparatively short

time is the general rule. The principal indication is cleanliness in the removal of the discharges, and of any mucosities or food that may escape over its surfaces. H. Bouley has experimentally proved that to obtain the cicatrization of œsophageal wounds it is essential "*to feed the animals with food of fibrous texture, and nothing but pure water to drink.*" By respecting this indication all danger of complications is avoided.

The possible accidents and complications are: *wounds of the blood vessels* during the first steps of the operation, but the hemorrhage that follows may be stopped by pressure or ligature; *œdematous swelling* of the wound, suggesting the infiltration of food or pus in the surrounding cellular tissue. It may terminate in a simple abscess, or it may be the precursor of a fatal gangrenous complication: *purulent infection*, *septicæmia*, *tetanus*, are also possible sequelæ of œsophagotomy, but a faithful and judicious application of antiseptic means in dressing and nursing the patients will usually baffle the possible evil.

GASTROTOMY—RUMENOTOMY.

This title, in our opinion, ought to include the puncture or incision of the rumen, when designed to liberate confined gases or to remove the solid contents which may have accumulated in that visceræ. In the first case it is indicated when the tympanitic condition of the first compartment of the stomach exhibits alarming symptoms and resists all ordinary remedial indications; and in the second, when the gases of the rumen are mixed with the alimentary mass contained in that organ and a larger opening than that made by the trocar becomes necessary, for their removal. In either case the left flank must be the seat of election for the operation, the rumen occupying that side of the abdomen, and situated at a point equally distant from the last rib, the angle of the ilium and the transverse process of the lumbar vertebræ. Tabourin suggests the last intercostal space as the proper place for the operation. The instruments necessary are a large trocar (Fig. 367) with a straight and a curved bistoury. The gastrotomes invented by Brogniez (Fig. 368) and Sajoux are too complicated. The animal must be in the standing position.

Puncture of the rumen.—The operator, facing the left flank, makes an incision through the skin, about an inch and a half long,

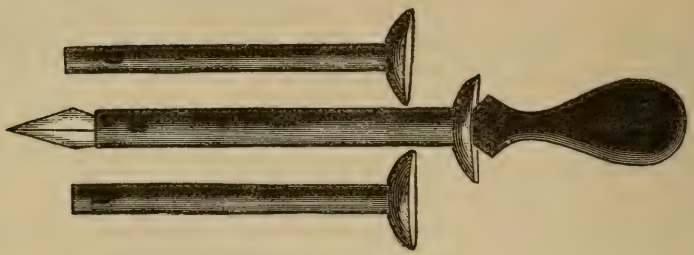


FIG. 367.—Large Trocars.

with the bistoury, or with the blade of a lancet. Then placing the trocar perpendicularly upon the flank and into the cutaneous incision, presses it against the muscles, and with his right hand strikes a heavy blow on the handle of the instrument and forces it into the cavity of the rumen, provided the blow has been sufficiently heavy. The blade of the trocar is then withdrawn, the canula being left in place, and the gases allowed to escape, as in the operation of enterotomy.

Incision of the rumen.—The operator, using a convex bistoury, makes an incision in the middle of the left flank, beginning a little below the point selected for the puncture of the rumen, and measuring a length of from three to four inches, cuts through and divides the entire thickness of the skin, and the walls of the rumen. The hand is then introduced and employed for the removal of the food contained in the cavity. The further cleaning out of the rumen may be done with a large spoon. Schaack recommends the removal of only a limited portion of the fermenting mass, and that the walls of the organ should not be scraped.

While the puncture of the rumen does not require to be followed by any special subsequent treatment, the wound of the incision needs to be closed immediately after the removal of the contents of the organ. This must be attended with every antiseptic precaution, and the closing be done by means of the interrupted suture. The parts should be thoroughly cleansed. Adhesion may be promoted by the application of a wide band of adhesive plaster placed all round the animal, as recommended by Professor Brush of the American Veterinary College. The wound of the puncture heals rapidly, while that of the incision requires from a week to ten days, and if properly treated, unites by the first intention, without suppuration. The accidents which are

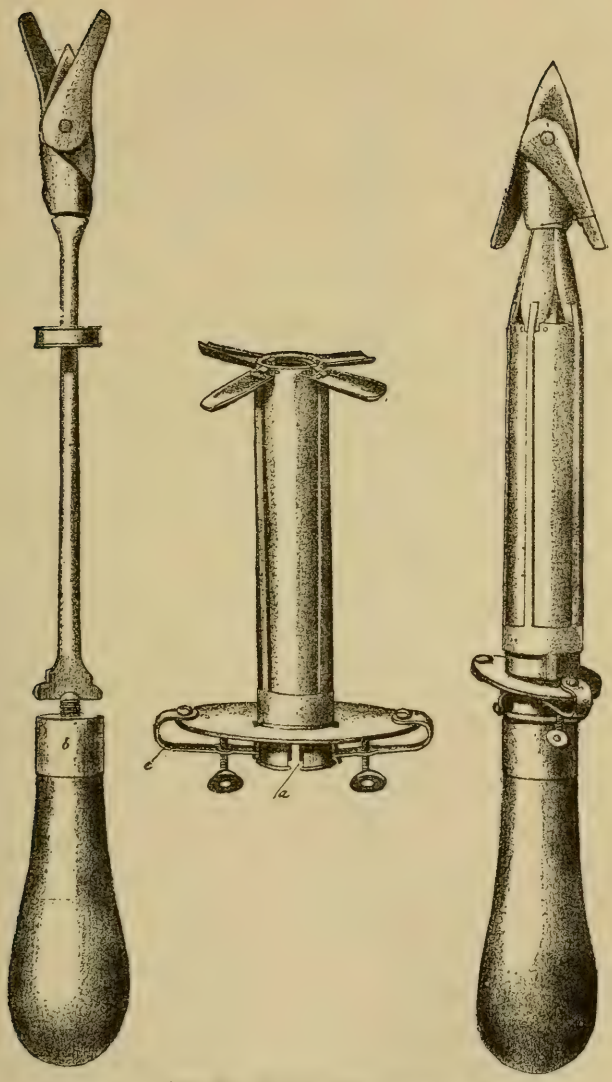


FIG. 368.—Brogniez's Gastrotome.

likely to follow these operations are subcutaneous emphysema, abscess, or peritonitis. The first of these is not uncommon, or dangerous; the abscesses are comparatively rarer; the peritonitis generally proves fatal.

ENTEROTOMY.

The division or puncture of the intestines, or *enterotomy*, is an operation the object of which is to facilitate the exit of gases contained in these organs, to prevent their excessive dilatation, and to obviate certain too commonly fatal complications. It was mentioned at an early day by Vegetius, especially in connection with the treatment of wind colics, but not again spoken of until 1776, when Roem, Bomvinghausen, and at a later date, Barrier and Herouard obtained good results from it. Bourgelat and Chabert recommended it in the early stages of the disease, but, notwithstanding the favorable dicta of all these authorities, the operation was not fully admitted to a place in the domain of veterinary surgery until Bernard, Dieterichs, Falke, Rey, Schaack, Hayne, Eckel, Blendeiss, Charlier and others, had proved by numerous facts that when performed under favorable circumstances it is not only harmless, but is capable of insuring results of the most beneficial character.

Intestinal puncture is indicated in cases of tympanitis or flatulent colic, due to indigestion, or to an intestinal obstruction, and must be performed whenever the accumulation of gases has resisted ordinary forms of treatment. The indication, in our opinion, is to operate early in the disease, as an almost positive means of avoiding the complications, or rupture of the stomach or laceration of the intestines, which, if unchecked, may accompany the flatulent accumulation. Enterotomy is also recommended in cases of strangulated hernia, when the gases which are imprisoned in the hernial intestines prevent its reduction. Imbert used it with advantage in reducing a strangulated ventral hernia. In former days Chabert performed the operation through the rectum, and Abadie, in 1875, reported a case in which he reached the intestines through the vagina. But while it may be possible to obtain access to the dilated intestines through these channels, it is evident that it is a method which must oppose more difficulties and involve more complications than the puncture through the flank.

The point of selection for the operation is about the center of the space formed forward by the border of the last rib, behind by the external angle of the ilium, and above by the extremity of the

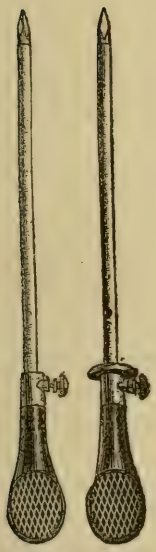


FIG. 369.—Trocars for the Cœcum.

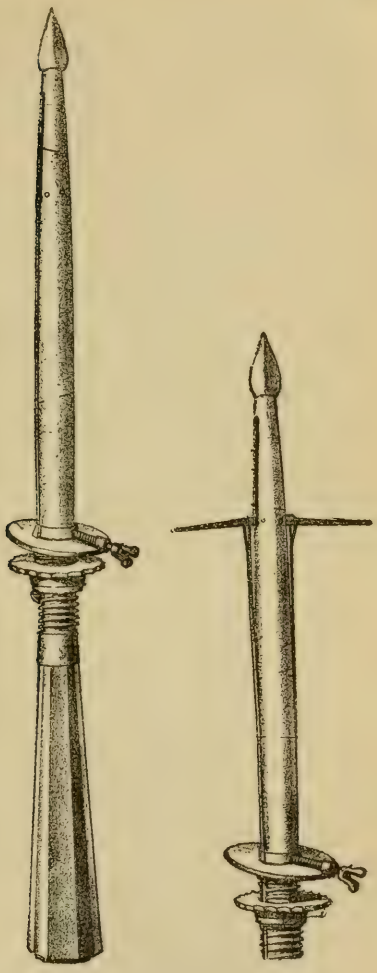


FIG. 370.—Brogniez's Enterotome.

transverse processes of the lumbar vertebræ, on the right flank—since it is there that the dilatation of the intestines is most prominent. The puncture, if made at this stated point, penetrates the second portion of the large colon; if it is made nearer the lumbar vertebræ, it enters the arch of the cœcum.

The only instrument necessary to perform enterotomy is a trocar. The instrument used in cattle for puncture of the rumen

was formerly employed, but it is quite unnecessary and of no advantage to use a canula of such dimensions merely to allow the escape of the gases. A small, round trocar is now in general use, and is in our estimation to be preferred to the ordinary flattened form of instrument (Fig. 369). The enterotome of Brogniez (Fig. 370) is too large an instrument, and its use endangers the walls of the intestines and the surrounding blood vessels.

Brogniez reports a case of injury to one of the cœcal arteries by the point of this instrument. We have frequently had recourse to the trocar of the epidermic syringe used for horses, when no other instrument was conveniently at hand.

The animal suffering with flatulent colics is treated while on its feet, and the pain it endures is usually of so intense a kind that no means of restraint are necessary, and it remains perfectly indifferent to the insignificant and minor pang of the operation. The principal caution to be observed, is to be on guard against the patient's suddenly falling, but if this should occur it need not interrupt the operation, which may be continued without forcing it to rise.

The *modus operandi* is very simple. The spot being acurately determined, the point of the instrument is pressed perpendicularly upon the skin with one hand, and driven by a strong, quick blow with the other upon the handle, through the skin and the intestinal coats into the visceral cavity. The withdrawal of the rod, leaving the canula in place, completes the process, by giving vent to the gases. These escape with more or less force, as announced by a whistling sound as they pass out of the tube. The intestines must then be entered from above downward, and not as recommended by Hertwig, who punctures the most dependent part of the abdomen, and thus exposes his patient to serious subcutaneous infiltrations.

Peuch and Toussaint suggest the propriety of making a small preparatory incision through the skin with a bistoury, previous to the main puncture with the trocar. The escape of the gases continues for a varying time, according to the amount of the accumulation. The instrument should continue in the wound while the escape continues, and until the tympanitic condition of the intestines disappears. If the escape of gas should suddenly cease, it will be because the canula is filled with fœcal or other matters, and the trocar must be re-inserted into its

canula until the renewed escape of the gas proves that the obstruction has been removed. If, however, they still fail to find an exit through the canula, a second puncture must be made at a short distance from the first. The wound of the punctnre requires no treatment.

According to Zundel, enterotomy is comparatively—in ordinary cases—harmless; still, however, complications more or less severe are possible, and have been observed. Hemorrhages, though of no alarming nature, have been noticed, and several cases of abscess have been recorded, either at the seat of the operation, or at the wound of the flank, and even in the groin. Peritonitis has also been encountered. Subcutaneous emphysema has been mentioned by Bouley; but in an experience of many years, we have never seen it. Laceration of the floating colon has been reported by Schaack. As a means of prevention against these accidents we would recommend great care in the introduction of the trocar through the abdominal walls, and especially a condition of thorough cleanliness, with a careful disinfection, of the instrument.

PARACENTESIS.

This term, with its synonyms of *puncture* and *tapping*, is at the present time applied exclusively to the operation performed upon the abdominal walls for the purpose of evacuating the serosity collected in the peritoneal cavity, as the result of dropsical effusion. It consists in puncturing the abdominal walls in the manner practiced in enterotomy and gastrotomy. The operations are similar, while the purpose varies materially in the several cases.

This operation had already been recommended by Vegetius—afterward employed by Vitet, as a last resort in ascitis. Lafosse, Jr., also speaks of it, and in more modern times we find it advocated by St. Cyr, Lafosse, Forster and others. Though in the majority of cases forming only a palliative treatment, it is nevertheless indicated in chronic dropsy of the abdomen, when all other forms of treatment have failed to produce the resorption of the fluid, especially when its accumulation interferes with the abdominal and thoracic functions. In these cases of ascites it has been performed upon horses, cattle and dogs. The injection of tincture of iodine into the peritoneal cavity, after the removal of

the effusion, has been successfully added as a means of preventing the return of the fluid.

In selecting the place where the operation is to be performed, Brogniez, Degives, Peuch and Toussaint advised the middle of the linea alba, at an equal distance from the xiphoid cartilage of the sternum and the anterior border of the pubis; Zundel, on the contrary, recommends "a puncture on the right side in ruminants, on the left in horses, on a point at an equal distance between the umbilicus and the external angle of the ilium, about on a line running from the stifle towards the cartilage of the last rib." He adds, however, "to select the point where the liquid is most detectable and fluctuation better felt."

A trocar of the size of a quill for large animals, and an aspirator for the small, are the only instruments required. In operating on large animals, they are kept standing, while small animals are laid upon a table and placed slightly on their backs. Placing himself on the left side of the animal, after having selected the place where the puncture is to be made, the operator, holding the trocar

FIG. 371.—Holding the Trocar in Paracenthesis.

full in his hand and limiting its action by keeping his fingers a short distance from the point of the instrument, pushes it by a rapid and firm pressure through the thickness of the abdominal walls, until he feels that he has overcome their resistance, and that the instrument has passed into the cavity. The trocar is then withdrawn from its canula and the fluid escapes through the tube. Director Degives describes another *modus operandi*, which he calls *subcutaneous*, in which the opening of the skin does not correspond with the division of the deeper muscular layers, and by which the opening becomes covered by the skin. To effect this the skin is drawn a little aside, then punctured, or a large fold of the tegument is taken hold of, and the puncture made at its base. In either case, when the skin is loosened, its retraction completely closes the abdominal opening.

If the escape of the fluid should stop or diminish, a blunt stylet can be introduced into the canula to clean it of any albuminous or epiploic mass which may obstruct it. The operation in small animals is performed in the same manner.

As the removal of the entire accumulation of the fluid is dangerous, though less so than in thoracentesis, it is better to permit a portion of it to remain. The quantity is sometimes enormous, ranging between thirty-five and ninety-six quarts. After the quantity desired has been obtained, the canula of the trocar is carefully withdrawn, and a bandage or roller of adhesive plaster placed around the body of the animal.

Among accidents possible in this operation, wounds of blood-vessels or of the intestines, and fatal peritonitis may be mentioned.

HERNIA.

General View.

In a general sense, any tumor formed by the entire or partial escape and protrusion of an organ, either wholly or in part, from the restraining tension of the integuments, or from the cavity which forms its normal location, is a hernia, or in popular phrase, a rupture. The more special application of the term is to the displacement of the abdominal viscera, but it is also employed to describe the *encephalocele*, or protrusion of the brain through the cranium; the projection of the iris and the *jabot*, or protrusion of the œsophagal mucous membrane, through its muscular coverings. And again the prominence of a synovial membrane beyond its ordinary bounderies: that of a muscle through its aponeurotic envelope; the prolapsus of the rectum; of the vagina; of the uterus, etc., etc.,—these also receive the same designation and are recognized members of the hernia family. We shall, in the present chapter, mainly limit our consideration to the displacements of the abdominal digestive organs.

The *rationale* of the formation of a hernia becomes a matter of easy comprehension, when we take into consideration the general anatomy of the abdomen, and especially the structure of its inferior wall. The muscular layers which form the exterior wall of this large splanchnic cavity are not of equal density through their whole extent, and consequently do not offer in every part an equal amount of resistance to the outward pressure of the interior

contents. In one place musculo-cartilaginous, or bony, it is in another, musculo-aponeurotic. In some parts protected by only a single layer of muscle, as in its anterior wall; in others the layers of muscular aponeurotic structure, or of fibrous bandages, are reinforced by a powerful elastic band, as in the inferior portion, by the tunica abdominalis. But besides this variety in the elements

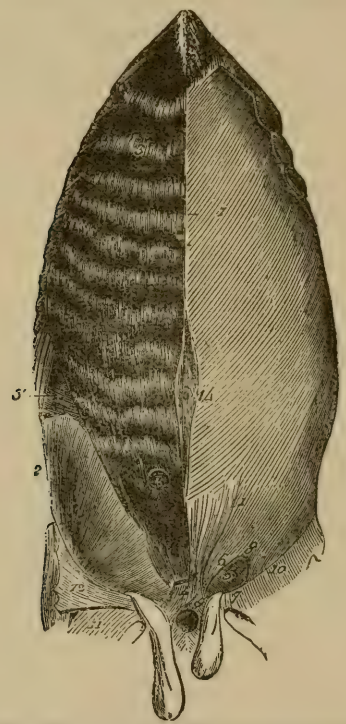


FIG. 372.—Muscles of the Inferior Abdominal Region.

1, aponeurosis of the great oblique; 2, fleshy portion of the small oblique; 3, straight of the abdomen; 3′, transverse of the abdomen; 4, pre-pubic tendon; 5, inguinal ring; 6, its anterior border; 7, the posterior; 8, external commissure; 9, internal commissure; 10, posterior border of the aponeurosis of the great oblique; 11, internal crural aponeurosis; 12, flap of the aponeurosis of the great oblique, drawn downward to show the origin of the reflex portion which forms the crural arch; 14, remains of the umbilicus.

forming the walls of the cavity, there is also to be taken into consideration the fact that, at certain points in the walls, natural openings exist, and that the abdominal cavity is therefore not strictly a close cavity. These passages consist of the inguino-crural openings, the umbilicus and those found in the diaphragm for

the egress of certain organs out of the abdomen, either during fœtal life or after birth.

The hernia, when not arising from a traumatic cause, is the result of some violent muscular effort on the part of the animal, in the course of which the viscera are made to exert a violent outward pressure upon the walls of the abdomen. If the pressure bears against any of the more solid portions of the wall, there will be no yielding, and the parts will remain uninjured and intact. But if the pressure becomes unduly violent, and the attack is directed against some one of the weaker supports, there must be a yielding, and the intestine or omentum, as the case may be, will be forced through the opening which falls most nearly in line with the direction of the violence. The resistance fails, the viscera passes through the aperture, and there is a protrusion, a rupture, a hernia.

Two elements must enter into the composition of all hernias, with the exception of eventrations. They are the *sac*, and the displaced organs which form its *contents*, and the mode of its formation may be readily comprehended by a consideration of the figures 373, 374, 375, which show the progressive displacement of the peritoneum, as it is pushed through the opening of the abdominal walls, by pressure of the intestines, which are also gradually passing through the same opening. The figures show in what manner the *hernial* or *peritoneal* sac is formed.

The sac is thus shown to be the prolongation of the peritoneum, which is displaced, moved and distended, or may have sustained partial laceration of its fibres. It may even happen that the rupture of that serous membrane is complete, and that it has become lodged in the cellular tissue. In such a case the lacerated peritoneum soon throws out a provisional reparatory sheath, which becomes continuous with the natural serous membrane.

Whether formed by the peritoneum itself, or by a membrane of secondary formation, the sac is always composed of a middle portion, or *body*, and an *opening*, or *ring*, which constitutes a means of communication with the abdominal cavity, with a *neck* or *canal*, a narrowed portion, uniting together the body and the opening of the tumor.

But little uniformity exists in the formation of the ring or opening of a hernia. In some instances it is round or oblong, in others it is a narrow slit, and again it exhibits a triangular outline.

FIG. 373.

FIG. 374.

EXPLANATION.—In these three figures an idea of the mode of formation of hernias is given: *aa aa aa*, represent a section of the abdominal wall; *o o o*, the aponeurotic opening through which the peritoneum, *pp pp pp*, is engaged to form the hernial sac, *s;* the intestine, *ii ii ii*, is shown entering the hernial sac gradually.

FIG. 375.

In the ventral kind the aperture is wide and of varying dimensions, and it may, moreover, be quite wanting, or again, it may be long and cylindrical, as in inguinal rupture; while in the umbilical variety it is very short, and represented merely by the thickness of the edges of the hernial ring. The *body* or middle portion of the intestines, or that which becomes lodged in the cavity of the sac, also varies in size, direction and form, and may be considered under the four principal heads of the *cylindrical*,

FIG. 376.—Cylindrical Hernial Sac.

FIG. 377.—Spheroidal Hernial Sac.

FIG. 378.—Conical Hernial Sac.

FIG. 379.—Pyriform Hernial Sac.

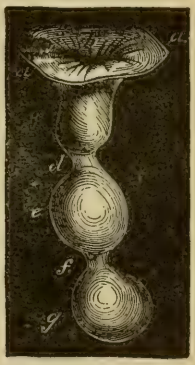


FIG. 380.—Hernial Sac in Clusters, or having three contractions—*f*, *d*, *b*.

FIGS. 381, 382.—Multilobular Hernial Sacs.

the *spheroidal*, the *convex*, the *pyriform*, to which Zundel adds the *clustered* and the *multilobular*.

The relation as to dimensions between the body of the hernia and the measurement of the ring is a point of importance in relation to estimating the more or less serious nature of a case. It will readily be inferred that with a narrow and contracted opening, an obstruction may easily take place, and at an early date, and that in due time the result will be manifested in the legitimate form of a *strangulation*, an accident which will be accompanied with various phenomena, according to the degree of pressure and the duration of the period of formation, and all of them attended with trouble and danger.

At first, as the capillary circulation becomes retarded and difficult, the intestines assume a red color, which passes successively through many shades, from deep red to brown or a blue-black, indicating the arrest of the blood, of which the dreaded sequel may be looked for in the appearance, a little later, of signs of mortification of the parts involved.

The blood then transudes through the walls of its vessels, and filtrates into the sub-serous and sub-mucous cellular tissue, thus increasing the bulk of the contents of the sac. At the same time the external surface of the protruding intestines becomes the seat of what is at first a yellowish exudation, but which becomes a bloody deposit, ready for organization if the patient lives long enough to survive the pains of the strangulation. By the eighteenth or towards the twenty-fourth hour, however, signs of total gangrene make their appearance and the hernial portion becomes flabby, cool, and insensible; the odor becomes very offensive, and the tissues easily lacerated or torn. The fatal end is then near, being rarely deferred beyond the twenty-fourth hour, unless immediate relief has been interposed.

But, of course, every case does not observe this regular succession of symptoms, nor reach the same final termination, and in the instances in which the interference with the circulation is less pronounced and the degree of pressure upon the protruding organ is lighter, probably not more than sufficient to interfere moderately with the movement of the intestinal contents, we have a modified evil to contend with in the *obstruction* or *engorgement* of the hernia, with consequences in view less discouraging to contemplate The exudation upon the surface of the contents of the

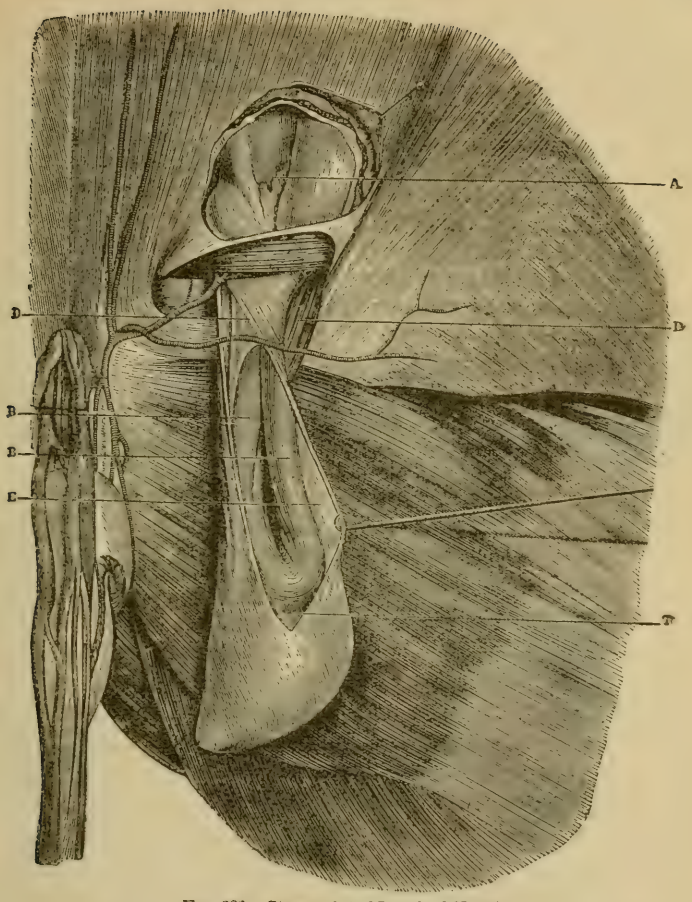


FIG. 383.—Strangulated Inguinal Hernia.

A, intestinal circumvolution. B, herniated portion of the intestine. D D, neck of the vaginal sac compressing the intestines. E, internal wall of the vaginal sac. T, testicle in the fundus of the vaginal sac.

sac has resulted in an *adhesion* with the internal surface, and the hernia has taken its place in the class of the *irreducible*. Hernias of long standing, which have, at intervals, shown indications of obstructions, are, in the greater number of instances, in fact, irreducible.

There are still, however, cases of simpler condition in which the viscera continue to be movable in the sac, in which fact they are due to the lubricating effect of a free serous exudation.

Aside from other distinguishing characteristics, all hernias are divisible into two classes—internal and external. Of the latter, some, as the eventration, have no containing sac, while the others, which have a serous covering, are in reality alone entitled to be considered as the true hernias. These, usually occurring through one of the natural openings, are called *natural*, in opposition to the *accidental*, which, like the ventral hernias and the eventration, occur through accidental and artificial openings. Any of the abdominal viscera, with the exception of the pancreas and the kidneys, may enter into the formation of a hernia, and as *each* is known by the name of the displaced organ, we are given the designations of *enterocele* for a hernia of the small intestines; *epiplocele*, for that of the omentum, and *entero-epiplocele* of both the intestines and omentum. The name of *gastro-ventral* is given to the ventral hernia which involves with it the stomach; *cystocele*, when it is the bladder which is affected, and *hysterocele* when the uterus is concerned. Hernias can be, moreover, *congenital* or *occasional*—that is, they may exist at birth or previous to it, and also when making their appearance under special causes after birth. They may be also considered as *acute* when recent, or *chronic*, when of long standing.

Their originating causes are numerous, and may be said to comprehend any which may predispose an animal to such a lesion by contributing to an increase of the pressure which the organs contained in the abdominal cavity bring to bear upon its walls, or any weakness in the walls, which may diminish their power of resistance to the pressure, as, for example, a condition of leanness arising from a sudden or recent change from a state of obesity; blows upon the abdomen; wounds and cicatrices of the abdominal walls; violent, jerking efforts, such as those required in compulsory jumping or hauling, or in any other of the struggles to which they are too often forced, and even when under the surgeon's hands, when, as a patient, the animal is cast and secured for an operation; the rapid relaxation after contraction of the natural openings, repeated pressure, or excessive dilatation, as with stallions used for covering mares, may be placed among the predisposing causes. They have also been observed in mares, after violent efforts during parturition; also during colics and other tympanitis. To recapitulate and partly to repeat

The general symptoms characteristic of hernias, are compar-

atively easy to recognize, and can be reduced to two principal points, to wit—the discovery of a tumor, and appearance of an opening coexisting in the abdominal walls. These tumors and openings offer many varieties of form and character. The tumor located opposite to a natural opening, or under a breach or separation in the structure of the abdominal walls, or under a cicatrix, forms a mass, indolent, elastic, remittent, of varying size, but diminishing or increasing under peculiar conditions, such as rest or pressure, and the standing, or the lateral or recumbent position, etc., and having different forms, being located in various places.

It has also, in many instances, the quality of being *reducible*, that is, it may be made to disappear by means of certain manipulations and appropriate treatment, and arrangements of position, to return to their previous status when these agencies are suspended; or again, they will become permanently *irreducible* under special pathological changes already alluded to. The presence of borborygmus is also an important item among the means of forming a physical diagnosis of these tumors. This is detected more or less readily when the displaced organ is a portion of the intestines. They are, however, missing when the hernia is formed by other organs, as, for instance, in case of epiplocele. Other points connected with this subject remain to be mentioned. Among these are the final symptoms, and more or less remote results, which may follow the presence and working of the lesion upon the general economy and the physiological functions at large, when the acute action has passed away.

The *constitutional symptoms*, or what may be so denominated, will vary, in their nature and their intensity, correspondingly with the condition of the hernia and the complications which may accompany each case. Among these complications, four principal ones may be mentioned as taking precedence:

1st. *Irreducibility.*—This is more frequent in old cases than in new, and is probably due to the increase in size of the displaced organ to the degeneration of the tissues, or to old adhesions between the organ and its covering, the sac. These cases, which may be considered rather permanent than merely chronic, maintain their *status*, either completely or partially, unchanged. Yet they cannot, naturally or rationally, be held to be compatible with a sound constitution or unimpaired stamina in the animals so conditioned, and their liability to contract indispositions easily

has frequently been remarked. Difficulty in the performance of movements requiring effort has also been noticed, with consequently a liability to suffer traumatic injuries from external violence. To this must be added a facility in contracting:

2d. *Inflammation.*—Generally this occurs as the result of external injuries, but it may also occur without any apparent cause. Its seat is the sac or its contents, and it affects the serous structures alone, or assumes a phlegmonous aspect. The inflammation of the serous tissue is often overlooked, while that of the phlegmonous cannot pass unobserved. It may sometimes assume a very serious character, and become even more dangerous than the true strangulation.

3d. *Obstructions* or *engorgements*, common in intestinal hernias, are due to the accumulation of alimentary or stercoraceous masses in the displaced intestines, or to gases which interfere with the reduction of the hernia. This is often complicated with strangulation, but is not in itself of a very dangerous nature.

4th. *Strangulation.*—This condition has been already considered. It is the result of excessive pressure upon the blood vessels of the displaced organ, and while under its three periods or degrees of congestion, inflammation, and gangrene, has usually a fatal termination.

The general treatment of hernia has the two objects in view of the destruction or obliteration of the sac, and the reduction or closing of the ring. If the first is not always easy to accomplish the reduction of the diameter of the ring often is so. Each form of hernia demands some special directions for the realization of these two objects, and these will each receive its own share of attention as they may in turn come under our notice in further treating the various forms of hernia.

Inguinal Hernia.

Inguinal hernia results from the passage or presence of a portion of the intestines, or of the omentum, or of both together, in the testicular or vaginal cavity whose opening of communication with the peritoneum or inguinal ring continues in its normal condition, having never closed. A brief survey of the general anatomy of the region involved will be a necessary preliminary to our discussion of the subject, which is one of interest and importance.

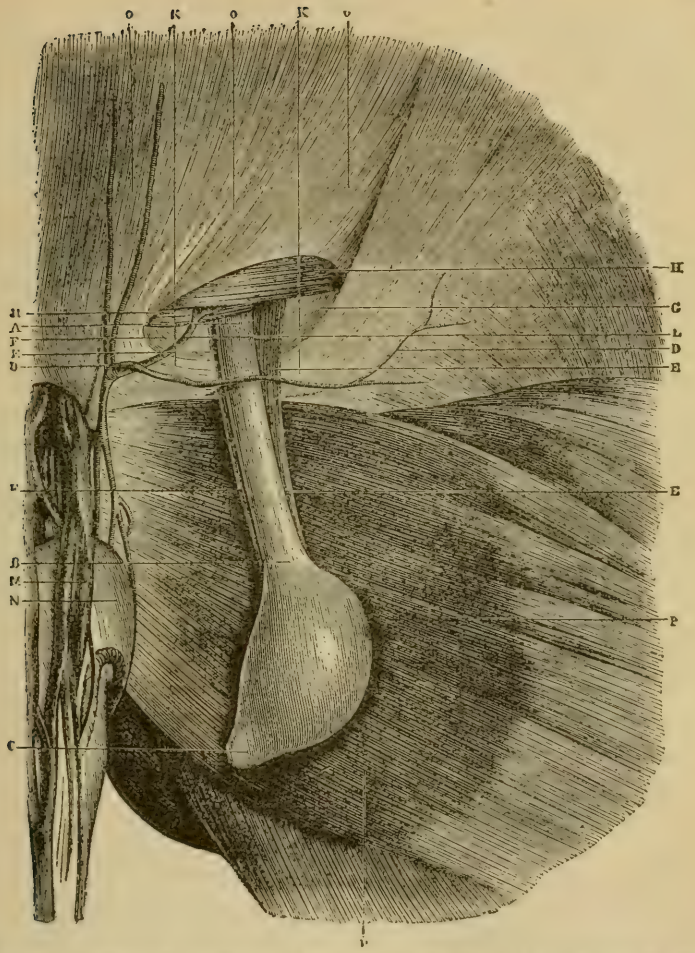


FIG 384.—Anatomical Disposition of the Inferior Inguinal Ring and Testicular Sac.

EXPLANATION OF FIG. 384.—A C, testicular sac, in which are shown—1st, the neck situated above the letter A, and concealed in the inguinal canal; 2d, a middle portion extending from A to B; 3d, a fundus, B C, where the testicle is. D D, division of the scrotal artery. F G, inferior inguinal ring, whose internal commissure is rounded and formed of white fibres crossing each other and attached to the prepubic tendon. H H, fleshy portion, from the small oblique, and forming the anterior and internal lip of the inguinal ring. K K, postero internal edge of the inguinal ring, formed principally by an aponeurotic portion of the great oblique. L, scrotal artery. M, veins of the scrotum and of the penis. N, part of the penis thrown backward. o o o, tunica abdominalis. P, muscles of the flat of the thigh, short adductor of the thigh.

The inguinal canal is an infundibuliform cavity, flattened from one side to the other. It is situated in the groin, and

through it pass the testicular cord and the testicular blood vessels, in the male, and the blood vessels of the mammæ in the female, as they emerge from the abdominal cavity. Situated on one side of the prepubic region, it observes an oblique direction, downward, backward, and from without inward, being formed posteriorly by the crural arch, and anteriorly by the fleshy portion of the small oblique muscle of the abdomen. Inferiorly it has an opening called the *inferior inguinal ring*, which is made through the aponeurosis of the great oblique, oval in shape, and possessing two *lips*, *edges* or *pillars*, united together by two *commissures*. The *lips*, divided into *anterior* and *posterior*, are formed by the fibres of the aponeurosis of the great oblique muscle of the abdomen, and a few of the muscular fibres of the small oblique, reinforced by some bands of the tunica abdominalis. The *commissures*, divided into *external* and *internal*, result from the union of the extremities of the two pillars. The *superior opening* of the inguinal canal is known also as the *peritoneal* or *superior inguinal ring*, and is situated in front of and directly opposite the *crural ring*. It represents a single slit, subject to dilatation, placed also between the crural arch and the small oblique of the abdomen, and allowing on its inner border the passage of the anterior pudic or posterior abdominal artery, it surrounds the neck, and forms the entrance of the vaginal sheath. It is open in horses, and often in bovines also, and it allows a direct communication between the cavity of the vaginal sac and that of the peritoneum—undoubtedly a predisposing condition to hernias, not to be overlooked. The *testicular sac* offers to our attention, from the point of view from which we now consider it, an *entrance*, or true infundibulum, overlapping the internal opening of the inguinal ring or canal; a *neck* situated just below that ring, a continuation of the infundibulum or entrance, and which at a short distance from its origin offers a well marked contraction in its diameter—this being the point where strangulation takes place—a *middle part*, containing the spermatic cord; and a *bottom*, or true cul-de-sac, where the testicles and the epididymis are lodged.

The special signification of the terms which have been elsewhere and already employed to designate and classify the varieties of form and manifestation characterizing different varieties of hernia are of interest, and should not be lost sight of. They are

divided principally into *recent* or *acute*, and *old* or *chronic*, and we find them considered as *enterocele*, *epiplocele*, and *entero-epiplocele*, according to their contents. The name of *vaginal* hernia has been used to denote a case in which the intestine is directly engaged in the inguinal canal; and *hernia of the ring*, or *hernia in the canal*, describes that in which the viscera have entered but a short distance into the sheath. *Bubonocele* signifies that the intestine has entered but a very slight distance into the inguinal sheath, in opposition to the *oscheocele* or *scrotal hernia*, when the intestine falls quite down into the sac, and with the testicles themselves, occupies the bottom of the scrotum.

Inguinal hernias are generally *accidental*, but, as some authors hold, are also sometimes *congenital*, having been found existing at birth; and in many instances they become *permanent*, the intestines occupying the vaginal sac without change, as a fixity. Then, again, they may be *intermittent*, disappearing more or less completely, under peculiar conditions, only to reappear under the stress of new influential causes. Of course the classification of *reducible* and *irreducible*, always holds. The classification of the hernia of castration, which takes place during or after that operation, is considered by some to be properly one of the forms of eventration.

A consideration of the anatomical disposition of the vaginal canal, and especially of its upper ring, which presents an opening communicating with the peritoneal cavity, will explain the reason why inguinal hernias of the horse are more common in the stallion than in the gelding. It is rare in bovines, but Lafosse has seen it in sheep and in rams and although the anatomical disposition of the canal in the dog render its occurrence difficult, Wolstein has observed it in that animal. Cases are rare in females, but Girard, Jr., has seen it in mares, Rychner in cows, and Hering, Hertwig and Goubaux in bitches.

Recent Inguinal Hernia.

When the hernia appears suddenly, in a subject *not predisposed* to it, the first symptoms are those of abdominal pain, appearing suddenly and without warning, and quite inconsistent with the general perfect health of the animal. These symptoms are at first vague in their significance, and definable merely as exhibitions of simple pain in the abdomen.

If in the stable, the animal becomes restless, paws with his fore feet, gazes earnestly toward his flanks, and flexes his legs, as if to lie down, and perhaps accomplishes that movement, but only to resume the standing position. The skin is moist, the perspiration appearing on the face, around the ears, behind the shoulders and in the groins. If he is in harness, his action is changed, he shortens his steps, stops pulling, wants to stand still, and becomes covered with abundant perspiration running over him and dripping from his belly. These first symptoms excite suspicion as to the real cause of the trouble, but they soon assume a character which changes the suspicion into certainty. They rapidly assume greater severity, increasing in the ratio of the sufferings of the animal, which then has no more rest or intermission, and gives evidence of the most intense abdominal pain. He paws and stamps upon the floor more and more violently, sometimes kicking his abdomen; gazes anxiously toward his flanks; lies carefully down and rolls to and fro on his back, sometimes keeping the dorsal position for a few moments, as if he could only thus find relief; then suddenly rises to his feet and repeats the movements, which give evidence of the torture he suffers, but more forcibly and rapidly than before. The expression of his face soon becomes characteristic. The lips are contracted, the nostrils are retracted and dilated, and the widely opened eyes appear unnaturally large and prominent, rendering their agonized expression more and more striking. The respiration becomes accelerated and the pulse more rapid; the perspiration streams more copiously from his body and the poor animal groans under the weight of his trouble.

After a lapse of some hours, the time arrives for the occurrence of strangulation, which may be pronounced the crisis or fatal event of inguinal hernia. It is characterized by a peculiar motion of the head, which is thrown up and down repeatedly (and which the French have designated by the word "*encensé*.") This motion, which is sometimes habitual with horses while in harness, has a peculiar meaning when it becomes the expression of the colic of hernia. It is then performed slowly, the head being elevated gradually and extended upon the neck, to be suddenly dropped again as if from weakness, to be again raised and dropped during the few and brief intervals of remission of the pains, while the animal possesses the ability to keep on his feet.

In fact, when the hernia is completed, the colics are so violent that the animal no longer *lies down*, but literally throws himself with violence upon the ground, having become forgetful of the natural instinct of conservation, and now rendered indifferent to all other pain by the overpowering force of the hernial torture. With his body covered with bruises, and bleeding from numerous superficial wounds, he now becomes a pitiable object. There are animals of particularly sensitive temperament which will even, like those in a rabid furor, bite themselves on their flanks and forearms in their delirious desperation.

During these excessive sufferings there seem to be just two positions in which the animal can experience a comparative degree of comfort. They are, lying on his back, or maintaining the dog-sitting posture, on his haunches. But these movements of reprieve are of but short duration, and the pains may continue to be manifested without cessation, by tumultuous, violent, unequal struggles, which may continue twelve or fifteen hours, or even more. At last, toward from the fifteenth to the twentieth hour, all the signs of pain subside, and a great calm succeeds to the previous violent agitation. This, however, is far from being a good sign, or an indication of the termination of the disease. It is, on the contrary, a sure token that a fatal termination is close at hand, and if the patient has ceased to suffer, it is because the anesthesia of death has fallen upon the organ in which his pains originated. The parts which were so recently altogether too much alive, have died. Gangrene has attacked the imprisoned intestine, and with its appearance, loss of feeling has also come—and death—for death is the loss of feeling. The animal is now in a condition of extreme prostration. The temperature is diminished; the perspiration is cold, the pulse is imperceptible, his face is without expression, the poor brute can scarcely maintain a standing posture or move his legs when urged to stir, and when the last remnant of his strength is exhausted, after a few hours, he drops upon the earth and dies without a struggle. Death rarely delays beyond twenty-four hours following the strangulation. This is the extreme limit, and in the greatest number of cases it takes place within a shorter period.

These manifestations (the description of which we borrow from H Bouley), constitute the series of general symptoms of hernia, but, at the same time, they do not belong exclusively to that kind

of injury. They are those of any violent abdominal pain springing from any cause, and may be met with in invaginations, volvulus, intestinal obstruction, etc. But if not possessing any positive and intrinsic significance in themselves, they assume great value in the diagnosis, when added to the series of *local*, or *pathognomic* symptoms which have their origin and limit in the inguinal region.

Two methods are available for the location of the seat of the lesion, one being the external exploration of the inguino-scrotal parts, the other consisting in the internal rectal examination of the pubic region. In a horse, and especially a stallion, suffering from colics, the indication to a general and immediate examination of the inguinal region, for abnormal appearances, is always present, and it will not be safe to be too easily satisfied with visual examination exclusively, to become certain that no part of the intestines is engaged in the vaginal sac. The eye may be deceived; it is the touch alone which will prevent all possibility of error. The sensation imparted to the touch at the beginning of a recent inguinal hernia is that of a thickened testicular cord which has lost its usual suppleness, and whose constituents can no longer be determined under the pressure of the fingers. Thus thickened, the cord gives a sensation of resistency, increasing as the exploration is carried further up in the groin, while toward the bottom of the sac, the scrotal mass feels fuller than usual, the testicle becoming less movable, giving the sensation of a slightly puffy tumor. After several hours duration of the disease, the characters become better marked, in consequence of the increase in the size of the intestine, and the amount of exudation, and there is also a formation of gases above the neck of the sac, which also contributes to its increase in size.

The hernial tumor has thus become changed from its original appearance, by its enlarged size, and is easily detected by the great general tension caused by the presence of the accumulating gases; the cord is found to be tumefied in its whole length, while its renitentcy increases as it extends upward into the canal. Direct pressure with the fingers upon the tumor does not seem to cause great pain, probably because this local sensation is dulled by the extension of the excessive pains which radiate from the hernia throughout the entire abdominal system. The external characters of the inguinal tumor become more noticeable when both sides of the testicular regions are compared, the difference between the

healthy and the diseased regions being then easily ascertained. Continued spasmodic movements of the healthy testicles have been observed.

In the rectal examination of the horse, the hand may be easily carried beyond the anterior border of the pubis, and the condition of the superior opening of the inguinal canal, and the state of the organs engaged in it thus ascertained.

In the normal condition, the anterior pillar of the superior opening of the canal is easy of identification. It is in front and on each side of the pubic region, and by reason of the extensibility of its muscular structure, requires no greater force for its separation from the posterior pillar than the introduction of two fingers into the ring. When the intestine is in the vaginal canal, after having passed through the superior opening, it can be felt with the hand through the walls of the rectum, its situation being generally on the inner side; and being thus recognized, it can be raised, pulled upon, and sometimes even extracted from the opening through which it had passed. But to be able to judge accurately the nature of the object which has been felt, requires in the surgeon an amount of experience in the taxis not always possessed, while its absence may at times betray the explorer into serious error. Moreover, the sensations transmitted through the rectum cannot in every case be truly interpreted, and it sometimes becomes necessary to combine the two modes of examination employed simultaneously—the rectal investigation and the external, manual, testicular exploration.

Thus, when with one hand in the rectum, pressing on the internal ring, and the other pushed well into the depths of the inguinal region, both are brought in contact, and it is discovered by the actual touch that the inguinal canal is clear, the hypothesis of strangulated hernia is at once negatived.

On the other hand, if there is hernia, and the imprisoned intestine is encountered, the fingers of the two hands cannot possibly come in contact, and the next question will be one of indication, if not of prognosis.

As a rule, the prognosis of recent inguinal hernia is always serious. If developed without organic predisposition it is necessarily a serious lesion by reason of its tendency to spontaneous strangulation, which when unrelieved means death by torture, unless the fatal event should be humanely anticipated and prevented by the

fiat of a compassionate master. But a fatal prognosis need not be unnecessarily volunteered. Timely and vigorous measures, especially emphasizing the "timely," may still prevent the strangulation and defer the sentence of mortality, and the sooner, therefore, the means of relief are applied, the more certain will be their effect. Every minute's delay increases the force of the disease and lessens the chances of success. It is rarely the case that the lapse of fifteen hours leaves any room for confidence, though it is not yet time to abandon hope. Within that period there are many chances for saving the patient, but after the earlier periods of the attack a single hour's neglect may be fatal—that hour may prove to be the turning-point of the conflict.

The treatment of recent inguinal hernia assumes two forms, consisting of the *taxis*, and the operation of *herniotomy*, or the enlargement of the neck of the vaginal sheath with a cutting instrument. The first mode is indicated at once, or as soon as the hernia is recognized. The reduction must be accomplished in the shortest time possible, the danger of strangulation becoming more imminent and threatening with the lapse of every moment. The taxis may give immediate relief, and may be materially assisted by douches of cold water.

In this case the taxis consists in the manipulation of the part with the hands, by pressure and otherwise, for the purpose of replacing the protruding intestine in its proper cavity; technically, the *reduction* of the hernia. This manipulation is applied either by simple pressure over the external surface of the diseased part, or, if practicable and necessary, by supplementing it with a proper traction applied upon the intestine from within through the rectal walls. This manipulation may be applied by two processes, first the *subcutaneous*, *medial* or *indirect;* and second, the *direct* taxis.

1st. *The Indirect Taxis.*—In the first or indirect method, the animal is placed in a standing position, with the hind legs secured. Then the hand and arm of the operator, well oiled, are introduced into the rectum, using the right, if he is to operate on the left side, and vice versa. When in the rectal cavity, the hand is carried to the anterior border of the pubis, while with the other, passed in front of the patella, pressure is applied upon the scrotal sac, and the intestine pushed toward the superior opening. The hand in the rectum then grasps the loops of the hernia, through the rectal walls, and at the same time pulls them upward. Through these

manipulations the surgeon may succeed in removing the difficulty, if by that time the testicular sheath continues to be free from congestion. But if this already exists, and the colics are increasing in severity, the taxis in the standing position becomes impossible and it will be necessary to throw the animal. This done, he must be placed in the dorsal position, with his hind legs kept apart and his haunches raised as much as possible by bunches of straw.

In this position, the operator must proceed to practice what must be described as an exceedingly delicate massage or taxis upon the scrotal sac, both hands being used, in such a manner as to crowd or press the intestinal mass toward the superior opening of the canal. The design of this is to stimulate the circulation through the capillaries, and also to free the cavity of the intestine from the semi-fluid and gaseous contents which may be present, by this means diminishing its volume and facilitating its reduction.

That this must be done with the utmost caution and patience, needs hardly to be urged. And it should be persevered in for at least a period of thirty seconds before advancing to the other step, which consists in gradually pushing the intestine toward the opening. If the protruding loop is not too long, and the massage has succeeded in its design, and the bulk of the tumor has been sufficiently diminished, and, above all, if the hernia has had but a short existence, it may be within the probabilities that this external taxis alone will be sufficient to reduce it. But such a result cannot be counted on with any degree of certainty, and it is then the simple dictate of wisdom to make assurance sure, if possible, by having recourse to double taxis, and attacking the danger at both its internal and external accessible points.

For a single operator to undertake the performance of both branches of this compound manipulation can hardly be advised. Few men possess the necessary powers of endurance, and an accident might easily compromise the very life of both surgeon and patient. At the least, it involves quite an unnecessary amount of effort and fatigue. All the reasons are in favor of a division of the work, by which a competent assistant will be put in charge of the rectal taxis portion of the labor, while the practitioner in chief will direct and execute all the other steps of the treatment.

The successful result of the operation will be known at once by the diminution of the tumor, the disappearance of its puffy and tense condition, by the sudden sensation of yielding, felt by

the hand working in the rectum, and also by the facility with which the fingers of that hand can be introduced into the now liberated superior ring.

Anesthetics have been recommended as powerful adjuncts in the application of the taxis, in this class of cases. Bouley recommended their use, and Baggè, a Russian veterinarian, agrees with Bouley, in advising their administration. His proceeding is thus described: The rectum being emptied, a solution of two to four grammes of chloral and sixty or seventy centigrammes of acetate of morphia are thrown into it, while at the same time compresses of chloroform are laid on the diseased side of the inguinal region. In the course of ten minutes there is such a relaxation of all the tissues that the reduction by rectal taxis is quite easy. The spermatic cords are then surrounded by rolls of bandages moderately tight, in order to prevent the return of the hernia. These bandages are left on for eight or ten hours. The danger of strangulation upon the testicular cords is an important objection to the adoption of this process. Severe applications of douches of cold water applied for one or two hours previous to the taxis have been successfully employed by Steff and Lacassin.

A process known as that of Patey, from its discoverer, consists in the injection of oil of belladonna into the hernial sac, the action of the oil, it is claimed, producing the dilation of the pseudo-sphincter, which prevents the reduction. It causes a certain flaccidity of the parts, renders the taxis much easier, and considerably facilitates the reduction.

2d. *The Direct Taxis.*—This procedure is of too dangerous a character to maintain a place in the domain of veterinary surgery, except under very exceptional conditions. It consists in applying the manipulations of the taxis directly upon the intestine, previously exposed by the dissection of the testicular envelopes. These manipulations, which are dangerous when the intestine is distended by gases or fluids, may, however, be rendered easier by relieving the intestinal loop, through the use of a fine needle-trocar or aspirator, of the cause of its abnormal dilatation.

The method of Renault, mentioned by Zundel, is also a form of direct taxis which, though it may be employed in cattle, involves a subsequent fatal peritonitis in the horse. The operation consists in the opening of the flank and the performance of the re-

duction by direct traction with the hand thus introduced into the abdomen.

The operation of *herniotomy* is that which consists in the section of the neck of the vaginal cavity. It is the proper operation for *strangulated hernia*. Bouley has said: "This operation is not, as one may be inclined to think, a last resource, which is not to be used except after the taxis, under its various forms, has been applied and failed. Far from it. We believe, on the contrary, that in the horse, the taxis is a means of treatment which is truly indicated only in the first five or six hours of the descent of the intestine; that even, in this first period of time, one must not use it too much nor too long, from fear of the complications which might arise through the rectal manipulations, and that after this limit of a few hours has elapsed, it is better to have recourse immediately to the operation, without trusting to vain hopes from the use of the taxis." The operation is comparatively a simple one, the dangers which were formerly apprehended having been greatly reduced by a better knowledge of the seat of the strangulation, and of the parts to be divided, and the ratio of mortality is now so small—forty-two recoveries out of fifty-two operations—that hesitation is no longer justifiable.

The instruments required for this operation are straight and curved bistouries, scissors, an ordinary director, a *herniotome* (Figs. 384*a*, 385), or blunt, straight bistoury, and a pair of curved clamps with strong cords to secure their branches. The *herniotome* is a *bistoury-caché*, which, however, since the use of general anesthesia, has been replaced by the blunt, straight bistoury, enables the operator to divide the neck of the vaginal sheath in the right place with more certainty than heretofore, and to regulate more accurately the dimensions necessary to relieve the strangulation. The director which is best adapted for use in herniotomy is one which has a flat, lanceolated, grooved surface at one end, and which, while it guides the blade of the bistoury, contributes likewise to the protection of the intestine against the possibility of injury by the sharp edges of the bistoury.

The patient to be operated on is laid upon a soft bed, anesthised as completely as possible, and placed upon his back. The hind leg corresponding to the side where the hernia is located is freed from the hobble, secured with a rope, and carried outward in abduction, with the rope made fast to a fixed point near by—

FIG. 384a.
Herniotome.

FIG. 385.
Herniotomes of Colin.

as a ring in the wall, a post, a tree, or other immovable object. If the operation is to be performed at night, which is too often necessarily the case, the presence of additional assistants will probably be required, in order to insure an abundant amount and proper management of light, which is indispensable in so delicate a dissection.

In operating, the surgeon kneels behind the patient and with a curved bistoury begins by making a long incision upon the tumor, parallel with the long axis of the testicle.

This incision is similar to that which is made in castration with covered testicles, and must involve only the scrotum, the dartos, and the first layers of the lamellated cellular tissue which unite this last to the tunica erythroidea. The remaining portion of this lamellæ is then carefully incised, until the fibrous coat is exposed, and the tumor is entirely enucleated from its envelope of cellular tissue. This done, the fibres of the tunica erythroidea are scraped apart with the point of the straight bistoury, until the vaginal sac has been opened, which the operator discovers by the appearance of a stream of liquid passing through. The canulated director is then introduced into the opening and

guides the bistoury, with which the hernial sac is now freely opened, in front and behind. This free cutting allows the escape of all the serous or sero-sanguineous fluid contained in the sac, varying in quantity according to the duration of the hernia.

The contents of the hernial sac are now exposed. They consist of the testicle, pushed outward, against the commissure of the ring; the loop of the intestine, placed on the inner side of the spermatic cord, rarely extending as far down as the testicle, but usually reaching to the level of epididymis, and again, not uncommonly remaining in the condition of a *bubonoale*. But whatever may be the dimensions of the protruding loop, the intestine is always easily recognized by the roundness of its form, the smoothness of its surface and its color, which may range from various shades of red to bluish black. It is also recognized by the changes which have taken place in its consistency, resulting from the bloody and serous infiltration which has taken place in its structure. The intestine should now be carefully wiped off with a soft, fine sponge, or washed with lukewarm water, in order to free it from any deposits or adhesions of serous or bloody matter that may be present.

The opening of the hernial sac should be immediately followed by the exploration of the neck with the index finger, with a view to the determination of the exact point where the strangulation exists, and to judge of its degree of tightness. This will not be found upon the superior opening of the inguinal canal, as thought by Girard, D'Arboval, Hertwig, Hering, Lafosse, Rey, Verrier and others, but should be looked for two or three centimetres below that opening, as demonstrated by Bouley; that is, where the neck of the vaginal sac is situated. This point made out, if the hernia is very recent, and the intestine has not yet become the seat of thickening, a few tactical manipulations can be applied, the internal face of the vaginal sac having first been lubricated with sweet oil, or some mucilaginous substance, or even oil of belladonna; and even cool irrigation has been of service. In the performance of this taxis the first step is committed to the assistant, who stretches both borders of the sheath in order to separate them in the form of a funnel, the testicle being drawn outward, in order to stretch the cord also. The operator then applies both hands upon the loop of the intestine, and with moderate and gradual pressure endeavors to push it through the neck of the vaginal sac. Rectal taxis applied at the same moment may also be of great assistance. But these

efforts must not be persevered in too long. If not successful almost immediately, it is better to have recourse at once to the incision of the neck of the sac than to expose the intestine to the subsequent effect of pressures or tractions of which the termination may be a fatal gangrene. The following steps are recommended by Bouley in making this incision. Says this author: "One assistant takes hold, with both hands, of the edges of the incision made through the vaginal sac, stretching them into a funnel shape; another draws the testicle outward and backward, to stretch the cord. Then the operator having explored with his finger the condition of the neck, introduces the blunt bistoury or the herniotome (Fig. 386) as far as the neck of the sac, taking for his guide the index finger of his right hand (Fig. 388), introduced into the neck or canulated director, and holding the instrument in such a manner that its back rests against the pulp of the finger which supports it, and its sharp edge turned outward, corresponds to the stiffened band of the neck, towards the internal face of the thigh. This band will thus become stretched over the knife in such a manner that it divides itself upon the sharp edge of the instrument, with the aid perhaps of the slightest pressure made by the finger which supports it. The important point is to make a very limited incision, dividing only the thickness of the vaginal sac and its fibrous covering, and avoiding the wounding of the cremaster, that being one of the conditions of the closing of the sheath. The division once made, the degree of dilatation of the neck is readily made out, and if the finger can be easily introduced into it, the reduction of the hernia becomes then an easy task.

Fig. 386.—Narrow blunt Bistoury used as Herniotome.

Fig. 387.—The bistoury sliding flatwise on the Grooved Directory.

The *modus operandi* by the use of the herniotome differs but little from the preceding. When this instrument

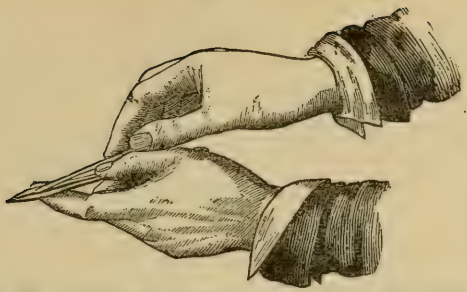


FIG. 388.—Holding the Bistoury upon the Grooved Director.

is to be used, a careful measurement of the amount of opening to be allowed to the blade must first be made. Then, guided by the side of the index finger, and with its blade turned outward, the instrument is introduced into the sac. When it has reached the proper point where the division is to be made, the blade is brought out by pressing upon the peculiarly-contrived handle of the instrument, and the division of the band of the neck is completed.

After the division at the point of strangulation, the taxis is to be used, both externally and by the rectum, carefully taking into consideration the condition of the intestines in the application of the various manipulations required.

Upon reduction of the hernia, obliteration of the sac is secured by the application of a clamp, curved or straight, upon its parietal layers, embracing between them the spermatic cord. In short, the final steps of the operation will be precisely those by which the operation of castration with covered testicles is completed.

This methed of closing the vaginal sac is the best, the simplest and the most certain in its results. It is true that the objection that it implies castration is a weighty one, but the mutilation which it involves is a condition of radical recovery which cannot be obtained by any other means. The attempts which are made to save the testicles, which are justifiable only in the case of very valuable animals used for breeding purposes, are nearly always followed by fatal results.

Among these may be mentioned the process by which, instead of leaving the testicle to drop under the effect of the pressure of the clamp, it is left inclosed in the vaginal sac, whose divided edges are brought together by sutures.

Schmidt has attempted to push it back into the abdomen; but such methods have been followed by fatal peritonitis. Bouley has

also advised a subcutaneous herniotomy, which was put into practice afterwards by Siegen & Verrier, in which the careful puncture of the sac was made at the origin, or, preferably, at the flabelliform insertion of the cremaster. After enlarging the opening, the index finger is introduced into the neck, carrying with it the blunt bistoury with which the structure is divided, and the reduction is completed by the taxis, the wound being closed by several points of suture. The use of antiseptics in our day obviates a large portion of the danger arising from the complications which may follow these modes of operation.

The operation for strangulated hernia in the gelding does not differ much from that indicated for stallions, except in the manner of closing the wounds, the clamp, in this class of patients, being applied upon the hernial sac, involving the skin, as is done in some cases of treatment for umbilical hernia.

The treatment of the patient subsequently to the operation is generally a simple matter, the violent colics, with other manifestations of the hernia, having suddenly subsided, and the patient being comparatively free from pain. He will probably give evidence of some slight abdominal uneasiness, which will probably be due to the pressure of the clamp upon the testicular cord, but this will not be of long duration, probably requiring no other attention than a moderate walking exercise.

The animal is then turned loose in a box stall and placed upon a diet suited to his case, and watched for future developments. The wound requires no special attention but cleanliness, and towards the fifth or sixth day, when the suppuration is established, the clamp can be removed.

It is about this time that complications may be looked for. A fatal peritonitis, for example, may appear between the fifth and tenth day, when everything has seemed to be progressing favorably, and bid defiance to treatment, especially if the intestines were already in a gangrenous condition when the reduction was made. After ten days there need be no more fear of complications, so far as the hernia is concerned, but it is not yet too late for those of castration, which may still occur. The duration of convalescence will average from twenty to twenty-five days, after which the animal can resume his work. A return of the hernia, *recidive*, is a rare and almost impossible event when the reduction has been completed by castration.

During the operation certain accidents may occur, including *eventration*, an *extra vaginal hernia* and *injuries to the intestines.* At the present time, eventrations are rare, by reason of the fact that the division of the superior ring itself is no longer performed. Yet they may occur through an accidental slip of the knife, or a tearing of the walls of the vaginal sheath during manipulation for the reduction, and the accident is usually a fatal one.

Of *extra vaginal hernia*, Bouley says: "While making the incision of the neck, sometimes the cremaster muscle is divided in the direction of its length; an accident possible, especially when one uses the concealed herniotome, and when too much freedom is allowed to its blade. It is then possible that the intestines may become engaged through this incision, and appear outside of the vaginal sac, above the inguinal ring. If at this moment, by misapplied taxis, the intestines should fail to re-enter the cavity of the sac, eventration may take place. But if, on the contrary, the intestine is first carefully returned into the vaginal cavity, and then into the peritoneum, the edges of the peritoneal opening of the canal being intact, the intestines will then be prevented from making another exit."

Wounds of the intestines may take place either through a misdirection of the bistoury during the struggles of the animal, or possibly from the nails of the operator or his assistants, and the fact of their possibility suggests a sufficient hint touching the obvious means of obviating their occurrence. The gravity of these injuries will be measured by their extent.

Old Inguinal Hernia.

Old, or chronic inguinal hernias, are those of which the characteristic condition is that owing to the state of dilatation of the vaginal sheath, the intestine contained in it is enabled, without jeopardy to the life of the patient, to continue its function in the same manner as if it had remained in the open cavity of the abdomen. The vaginal sac has in this case become a kind of large diverticulum of such dimensions as to allow, without interference, the work and motion of the intestinal tract, lodged within it, to go on in a natural way. These hernias are divided into *continued*, or *permanent* and *intermittent*—a division elsewhere alluded to—but they may also be distinguished as *simple* and *complicated.*

Among the varieties belonging to the latter category may be named: the laceration of the superior opening of the testicular sheath; the collection of serosity in the sac (hydrocele); the sarcomatous transformation of the testicle where the hernia exists (sarcocele); the adhesion of the intestines to the walls of the sac (irreducible hernia); with obstruction and strangulation.

Although their causes belong to the list which we have already considered, there is still a sort of latent difference observable in the effects to which they severally give rise, as evidenced by the slowness and tardiness of their maturity. They often appear, also, as a sort of relapse or reactionary sequelæ (*recidive* of the French) of acute hernia improperly reduced, or as a consequence of the abnormally dilated condition of the upper ring, while this constitutes a predisposing cause. But this same condition of dilatation may be congenital, and in animals with a predisposing conformation chronic hernia of the intermittent kind is of easy occurrence. Whatever may be their mode of formation, however, they are generally of long standing, and readily diagnosticated by their positive and familiar characters.

Chronic hernias are generally of larger dimensions than the acute, and when exclusively vaginal, filling the cavity of the scrotum and forming a true oscheocele. If the laceration of the superior opening of the canal has allowed the formation of a sac and of an adjunct tumor, in front and outside of the cord, the hernial tumor will then consist of two lobes, the smaller situated in the depth of the groin, under the ventral walls, and the larger occupying the scrotal sac.

These hernial tumors are usually formed by the small intestines and the floating colon, in exceptional cases, by the pelvic curvature of the colon as well. They vary also in volume as well as in consistency, from an obvious cause; enlarging after meals, to contract again when the abdomen is empty; and again, giving various impressions under the hand, according as their contents are gaseous, liquid or solid. In the first condition, when the intestines are empty and the animal is at rest, the tumor is soft, supple, elastic and more or less reducible, but when the animal is in action it increases in bulk, and becomes more tense and elastic, and less easy of reduction. There is therefore a condition of intermittency in their character, which is due to the peculiar conditions in which the animal may be placed. The form of these tumors corresponds

to that of the testicular sac in which they are contained, the inguinal oscheocele being pyriform, with its contracted portion resting in the groin.

Vermicular movements of the intestines and borborygmus are symptoms easily detected in large hernias. The tumor of a chronic hernia is painless, or nearly so. Rectal examination furnishes evident indications of the possibility, and of the presence of the hernia by the degree of the dilatation of the ring and the size of the organ engaged in it. In such a case, the dilatation may be so great, even notwithstanding the presence of the intestines, that the hands, placed respectively, one in the rectum and the other in the inguinal region, can be brought in such near proximity as to touch each other. All these symptoms, taken together, or even isolated, are sufficiently characteristic to establish a positive diagnosis of simple chronic hernia.

The serous exudation which necessarily exists in chronic hernia, may, when it is excessive, render the nature of a hernial tumor more obscure, and give it the appearance of a case of true *hydrocele*, the serous sac in these cases being so full as to render it impossible to discover, either by sight or feeling, the presence of the intestines contained in it, even the elastic resistance of its walls being undetectable. But here a rectal exploration will help to solve the question; and, again, by placing the animal in the dorsal position, the gravitation of the liquid into the abdomen will readily reveal the truth by leaving the intestine alone in the sac.

Great caution is necessary in these doubtful cases, in which a misdirected stroke of the bistoury, thoughtlessly or accidently made, might prove certainly fatal, by incising the intestinal knuckle, which it really is, instead of simply opening the mere serous sac which it was supposed to be. The formation of a *sarcocele* may also render the diagnosis difficult. In these cases the testicle, considerably tumefied, rough on its surface, and hard and painful, is felt at the bottom of the sac, and thus conceals the character of the hernia. Still, with sarcocele hernia coexistent, the scrotal tumor acquires an appearance and proportions different from those of its uncomplicated state. In this last case, the testicle constitutes the principal mass, and the elongated cord, stretched by the weight of the organ, can be easily traced with the fingers quite up into the groin. If, on the contrary, both hernia

and sarcocele are present, the testicle is bosselated and hypertrophied, and the cord which supports it is surrounded by the protruding intestines, which form on the outside an elongated mass, of a consistency either puffy or perfectly elastic, according to the period of digestion. Intelligent rectal exploration will always reveal the presence of the intestine through the ring.

When chronic inguinal hernia becomes complicated with *acute inflammation* of the displaced organ, the scrotal tumor becomes warm, painful, evenly tense and remittent, and assumes nearly all the characters of a phlegmonous tumor, that a strong temptation is offered to open it with the bistoury. But, if this is contemplated, it should be preceded by a rectal examination, carefully made, as the only means of avoiding a possible error of diagnosis whose consequences would be fatal. If the inflammation continues to be localized, the intestine contracts adhesions with the walls of the sac, and the hernia becomes irreducible; but if, on the contrary, the phenomena of inflammation extend to the peritoneum, an acute *peritonitis* is established, and the patient succumbs in a few days.

The *obstruction* or *engorgement*, which is a possible complication of chronic inguinal hernias, consists in the distension of the intestinal loop by the lodgment of alimentary masses of varying bulk which accumulate, and for the time being, occlude the intestinal tract. This complication may be recognized by the increased volume of the tumor, its greater weight, and the sensation of a softish and puffy mass contained in it. It is often, however, but a temporary trouble, the colics which attend it yielding easily to appropriate treatment, and the removal of fæces from the rectum by back-raking being often sufficient in itself to afford relief. But in exceptional cases, treatment fails; the obstruction becomes persistent; the fæces accumulate in the protruding intestines; the tumor is increased in bulk, and at length a period arrives when such a disproportion between the volume of the distended intestine and the capacity of the opening through which it has passed is established, that all the conditions necessary for strangulation are fulfilled. This soon takes place and becomes evident by the exhibition of symptoms akin to those pertaining to its analogue of the recent or acute variety. There is, however, a difference between the two forms in respect to the important matter of their comparative amenability to treatment, inas-

much as while strangulation in the acute cases is only relieved with great difficulty, without resorting to the operation of herniotomy, it is not uncommon in those of a chronic character, also strangulated, to succeed by a careful exercise of the taxis, in displacing the alimentary mass which causes the obstruction, and thus forms one of the contributing conditions of the strangulation. It is only in case of failure in this endeavor that herniotomy becomes admissible.

A chronic inguinal hernia is always a serious ailment, though not necessarily incompatible with the life and health, and even partial usefulness of the horse. It must, however, constitute a blemish which cannot fail largely to depreciate his commercial value, since it must always be liable to interfere with the efficient performance of his accustomed labor, besides keeping him in a state of greater or less exposure to complications and tendencies which are a constant source and menace of danger to the valetudinarian animal.

Operations for the relief of hernia are always attended with a certain gravity, even when they are of the simplest character of which they are capable, and if complications exist the danger must necessarily be intensified and aggravated, even to the extent of jeopardizing the life of the patient. In the excellent work of Peuch & Toussaint, speaking of the applications of treatment, they remark: "In animals less than fifteen months of age suffering with hernia, the expectant method is the proper indication, since the lesion may disappear as the animal gets older and develops. Inguinal hernias of small size must be left alone, not interfering, while in that condition, with the work of the animal. The operation in chronic inguinal hernias, complicated with laceration of the superior opening of the inguinal canal, and consequently with ventral hernia, is contra-indicated by the imminent danger of the occurrence of eventration during the operation, or when the clamp is removed. When, however, the hernial tumor has assumed such enormous dimensions, that, like the udder of a cow, it hangs down to the hocks, there is no more contra-indication, the animal being then useless - and yet some slight chances of success still remain. Hernias complicated with hydrocele, sarcocele or obstruction, are cases calling for operation, and when the point of strangulation has been reached, the indication of immediate and urgent interference is imperative."

To this we may add, with Bouley, that the operation is also indicated when the hernia is exclusively vaginal and of sufficient proportion to interfere with the locomotion of the patient. It is also indicated as a means of preventing its further development. The operation for chronic inguinal hernia identifies itself with that of castration with the use of the clamp, and by the process known as covered testicles, as it is by this alone that the accomplishment of the ultimate purpose in the reduction of the hernia and release of the strangulation can be obtained. The instruments required are those needed in castration. The clamp, however, requires to be of increased length and dimensions, and

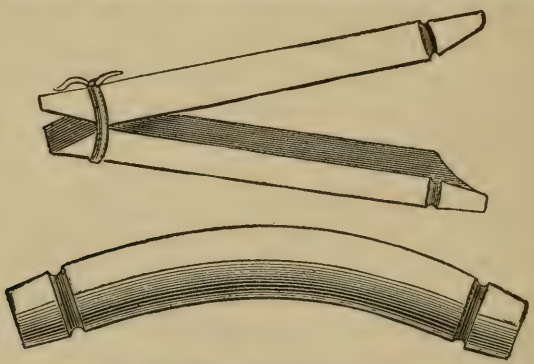


FIG. 389.—Straight and Curved Clamp.

curved, in order to adapt itself to the parts. A broad cloth, such as a bed sheet, may prove useful to receive and protect the intestines in case they should protrude too extensively.

The animal is placed in the decubital position on his back, with the leg of the affected side maintained in abduction. Anesthetics are generally used, especially when there are fears of complications, while, in fact, they ought never to be omitted. The operator then, with the convex bistoury, makes carefully, on the inferior border of the hernial sac, an antero-posterior incision, parallel to the median raphe of the scrotal region, cutting through the skin, the dartos and the first layer of the cellular tissue underneath. He then with his hands tears the adhesions which exist between the dartos and the tunica erythroidea, in order to enucleate the hernial tumor in its entirety. This step is easily effected when the cellular tissue, which covers the fibrous coat, is not indurated, but if that should be the case when adhesions exist, the

dissection should be carefully made with the knife until the adhesions are completely divided and the fibrous coat fully exposed. The reduction must then be attempted without opening the sac, and in the absence of any adhesions this is effected without difficulty, the inguinal opening being so large that, through the force of mere gravitation, the dorsal position in which the animal is placed is often sufficient in itself to cause the return of the intestines into the abdominal cavity, even the testicle and the hernial sac often following it in its inward movement.

If the reduction does not take place in this manner, or in consequence of the position of the animal, the taxis, both scrotal and rectal, is then indicated to be performed in the same manner as for acute hernia. Difficulties in effecting this reduction may arise from three causes—either, first, the bulk of the mass represented by the protruding intestines; or second, its obstruction; or third, the adhesions which it may have contracted with the walls of the sac or with the spermatic cord.

To obviate the first difficulty, while the manipulations of the taxis, scrotal and rectal are simultaneously continued, it will be well to relieve the position of the animal, and instead of keeping him lying absolutely on his back, to allow him to turn slightly, and to rest on the side opposite the hernia. In this way the mass will not be so heavy to manipulate, and will be in a better position to follow the dependent direction in which it must be pushed by the scrotal taxis, while at the same time, by the rectal manipulation, it can be more easily unfolded and drawn from the cavity in which it was imprisoned. But if, notwithstanding all these precautions, this difficulty in the reduction cannot be overcome, the indication of opening the sac still remains.

The incision of the sac is performed as in cases of recent hernia, the bed-sheet already mentioned being held in readiness to receive the intestinal mass as it will be exposed. Then the animal being completely under the influence of ether, and in the dorsal position, an assistant grasps the edges of the sac and stretches them apart, funnel-wise, using both hands alternately, gradually pushes the intestines towards the hernial opening, an assistant at the same time slowly unfolding the mass and permitting it to slide into the abdominal cavity.

Rectal taxis may largely assist in this step of the operation.

If the reduction is rendered impossible by the interposition of

obstructions, the first indication will be to evacuate the intestines by a methodical pressure which will displace the alimentary mass and return it toward the abdomen. The puncture made with the aspirator has proved very beneficial in these complications.

The adhesions require the most careful dissection, especially when they are short, and when both the visceral and parietal layers of peritoneum are closely united. The separation must be done by a succession of short, limited incisions, at the expense of the thickness of the parietal layer.

When strangulation of chronic hernia occurs, it is due not to want of room at the hernial ring, but to the enlarged bulk of the protruding organ, which constitutes the obstruction. Consequently the indication for herniotomy is not present. On the contrary, as serious eventration is always to be feared, the only indication is the removal of the obstruction as already indicated.

When the reduction has been completed, the occlusion of the vaginal sac is to be obtained by the application of the clamp, applied as high up as possible, as in cases of strangulated acute hernia.

In cases of inguinal, complicated with ventral hernia, attempts at reduction may be made by placing a long clamp over the coverings of the latter, involving with them the hernial sac and its cutaneous envelope, as practiced in some cases of the umbilical form.

We need but briefly to refer to certain different modes of treatment of the various forms of hernia by the use of bandages, recommended by Petard, Grau, Klinger and Marlot, together with the application of sutures upon the edges of the inguinal canal, patronized by Hertwig and Dieterichs, to say that none of these, any more than some others, borrowed from human surgery, can give more satisfactory results, or be employed with greater safety, and effect a radical cure better than the use of the clamp and the castration by the process of the covered testicle.

Inguinal Hernia in Geldings.

Although inguinal hernia in the gelding is certainly less common than in the stallion, it is not, therefore, of impossible occurrence. But from the fact of its rare appearance it is far more likely to be overlooked, and therefore neglected, with similar fatal

results to those in the stallion, when it reaches the stage of strangulation.

From the fact that, as the result of castration, the superior opening of the testicular sheath is more or less closed, it becomes a matter of rational inference, that hernia in a gelding is not of posterior occurrence to castration, but that its existence is due to a congenital disposition, and that by the operation of gelding they have been reduced to their smallest proportions, in relation to the dimensions of the intra-vaginal sac, to the dimensions, in fact, of a bubonocele, which continues unobserved in consequence of the smallness of its size, and the depth of its location.

These hernias are detected outwardly by a physical symptom, to wit, the existence in the inguinal region, on either side of the penis, and above the cicatrix of castration, of a tumor about the size of an egg, soft, depressible, altogether painless, sometimes elastic and at times puffy. It varies much in size, diminishing with rest and quiet, and increasing with effort and active movement. It may, in fact, under the first condition, entirely disappear, to return as soon as the animal is put to work. In a word, it has the true character of being intermittent. Aside from these symptoms, rectal exploration furnishes positive data of its existence, by the abnormal dilatation of the ring, easily detected, and by the pressure of the intestines lodged in it.

This hernia is also susceptible of strangulation, and is then accompanied by violent abdominal pains, which must not be ignored as to their possible diagnosis and significance. The indication for careful examination in that direction must, indeed, never be overlooked in cases of violent colics in geldings. If these colics are due to strangulated hernias, the presence of a round, tense, resistant and painful tumor will be detected in either of the inguinal regions, and, according to Bouley, more commonly on the left than on the right side. The strangulation in this class of hernia is generally irreducible, and becomes rapidly fatal; if not relieved immediately, it is not relieved at all.

The first indication of treatment is the reduction of the hernia by simple, external taxis, or by combining with it the rectal taxis. The reduction will be followed by the disappearance of all the symptoms, and the animal will be apparently well, until a second attack takes place. After the reduction, steps must be taken to prevent its return, by an operation similar to one of those used in

umbilical hernia, to obtain the reduction and retention of the intestine, by the application of a proper clamp upon the sac covered by the scrotal skin.

The treatment of the gelding for strangulated hernia does not differ from that of the stallion. Ordinarily, the taxis is sufficient to reduce such complicated hernia, but in case of failure in obtaining rapid success one must be careful not to carry on the manipulations so long as to encounter the risk of lacerating or tearing the tissues. The wiser and safer plan will then be to have recourse to the operation of herniotomy, an operation which should be performed with the greatest care in separating and dividing the existing cicatricial adhesions of castration. The clamp is afterwards placed upon the hernial sac, with its cutaneous covering, requiring a longer time to slough, and constituting a means of retention most favorable to the success of the operation.

Crural Hernia,

or *merocele*, is that form of rupture in which the abdominal organs make their escape through the crural ring. It is a rare affection among our domestic animals, but has been seen by Lafosse, Jr., in the horse, by Girard, Jr., in the dog, by Dandrieu in cows, and by Hertwig in horses, donkeys and dogs. It is said to be more frequent in males than females. It results from violent muscular efforts, and especially from the slipping apart of the legs when already separated or straddling in abduction. It is characterized by a somewhat well defined tumor, of moderate size, situated behind the inguinal ring, towards the middle of the flat part of the thigh. When the rupture is recent, the animal is somewhat stiff in his gait, especially on the affected side, and carries his leg in abduction. There is also a degree of lameness. According to Hertwig, the tumor is easily reduced, and not very painful. In a few cases it may be complicated with strangulation. The organs which have been found in the sac have been portions of the small intestines; the omentum, as reported by Hertwig, and the bladder, in one cow, according to Dandrieu. The prognosis in cases which receive early attention, is not serious.

The treatment consists in reducing the rupture, and afterwards closing the passage through which it occurred. This is effected by making an incision through the skin over the tumor, and closing

the ring with a few stitches upon Poupart's ligament and the small adductor of the leg. A good blister rubbed over the enlargement completes the treatment. According to Zundel, three weeks of subsequent rest are required to assure recovery.

Perineal Hernia.

This is a very rare lesion and, as Zundel describes it, is the passage of the peritoneum and viscera through the vasculo-aponeurotic floor of the bottom of the pelvis. It is, however, reported to be common in dogs, in which animal it is situated between the ischium, the sacrum, the anus and the urethra, and is often mistaken for an abscess. It is more frequently formed by the bladder than by the intestines.

Pancreatic Hernia.

This hernia was first observed by Prinz, and afterwards noticed by Husson, Roell, and others. It is caused by the strangulation of the jejunum and the anterior part of the ileum through the hiatus of Winslow, the orifice above the right angle of the pancreas, and of the vena cava, in front of the right kidney. It is accompanied by symptoms of intestinal congestion, and cannot be reached by any form of treatment, if indeed it can be accurately diagnosed during life.

Pelvic, or Internal Hernia of Oxen.

This form of hernia is principally described by Zundel, from whom we extract the following: "It is the strangulation of a loop of intestines, which has pushed through the ruptured peritoneum, from before backward, between the testicular cord and the lateral wall of the pelvis, the rupture of the peritoneum having resolved during some of the manipulations of castration from excessive stretching of the cord, as in the operation by tearing. It is, therefore, exclusively a lesion of the ox, and cannot affect the bull. It is quite common in Germany, and has been met with in England, Mecklenburg and Alsace. It was first described by Oesterten, in 1811, followed by Anker in 1824, and later by Zundel, Ostertag and Tues. It is comparatively often seen, and in many cases overlooked. The first intimation of the presence of the disease appears in the onset of symptoms of a violent attack of colic. The animal becomes anxious and restless, lies down hastily and rises again

suddenly; turns about, moves to and fro, lashes with his tail, and, in a word, betrays all the usual signs of intense suffering, and it becomes difficult, if not dangerous, to approach him in order to make a proper examination. The temperature of the body is elevated, there is some perspiration, the nose is hot, though still moist; both respiration and circulation are accelerated. The animal refuses food or drink, rumination is suspended, and though defecation has not ceased, the fæces are hard, blackish and coated.

In from six to twelve hours, this state of febrile excitement subsides, and the animal becomes dull and quiet, gazing towards its flanks, the ears dropping, the hind leg corresponding to the side of the hernia is extended backward, and at the same time the lumbar region is relaxed downward. If the animal is lying down he may remain quiet for a while, with his hind leg still extended, but will presently spring to his feet with his back arched as before, at the lumbar region, but which drops again and straightens immediately. When he walks it is with a stiff action, principally towards the diseased side; the extremities are cool, the pulse is small and insensible, respiration is accelerated; constipation at length becomes complete with mucous and bloody passages, perhaps accompanied with flatulence, but micturition is still easy.

Two or three days later there are other changes. The period of calm terminates, and is succeeded by a season of alternating agitation and repose—action and reaction of the fluctuating inflammatory process.

The animal now and then utters grunts of pain, his pulse becomes smaller, and is at length imperceptible, and all the unfavorable manifestations are exaggerated. Either gangrene has supervened, or, as some would judge, enteritis, and all the symptoms point towards the more fatal termination.

It is only by rectal examination that the diagnosis can be positively established, and when this has been carefully and successfully made, he will have discovered what may be thus described: a puffy mass, indefinite as to size, situated usually nearer the sacrum than the pubis, on the side of which, generally the right, a portion of the intestines has slipped under the testicular cord—this being the definition of a crural hernia. It may be a simple protrusion of the intestine, and again, this may be twisted around the spermatic cord, a condition particularly likely to terminate in strangulation.

This lesion may continue as long as nine days, four to five being the average duration, and it may terminate by spontaneous reduction, but the trustful surgeon who too confidently and too often expects to find that Nature has dispensed with his aid in this kindly way, is doomed to encounter many disappointments. Or it may end in gangrene or enteritis.

The fact that the disease, if not interfered with, may terminate fatally in so brief a period as five days, of course renders the prognosis quite a serious one, unless the nature of the ailment has had an early identification and measures have been taken to avert the danger. The gravity of the prospect is, of course, increased when the complication with strangulation or enteritis, as before mentioned, enters into the case.

The treatment, as in other cases, consists in the reduction of the hernia. With a small proportion of patients this may be effected by the simple act of causing the animal to walk down a steep declivity—a sort of spontaneous, or semi-spontaneous cure, from which, although founded on anatomical principles, too much must not be confidently expected. We copy from Zundel his description of other and more scientific methods:

(*a*) *Reduction by Simple Taxis.*—The animal is placed on an inclined plane, with his hind-quarters raised, and an assistant on one side of him ready, at a given moment, to press on the loins. The operator, with his hand in the rectum, searches for the intestinal loop, and when he has found it, holding it in the bottom of his hand, he feels for the opening under the spermatic cord, which he dilates with his fingers, and now, while the assistant presses hard on the loins, as just mentioned, the intestine may be readily felt moving downward and forward under the cord, to resume its normal position. Although simple, and, in the majority of cases, successful, this mode has the defect of leaving the animal exposed to a return of the hernia.

(*b*) *Reduction by Laceration of the Cord through the Rectum.*—This method is recommended by Metzger, Eisele, Schenck, Gierer and Ostertag. It consists in tearing away the adhesions formed by the stump of the cord after castration, and loosening it from the inguinal ring. It is, however, difficult to do, and not without danger. The hand being introduced into the rectum, and the opening found, the fingers are closed in the form of a wedge, and with a slight movement of rotation pushed through

the opening, and the cord thus separated from its adhesions. After a while, the pressure, which was quite firm at first, diminishes, and the intestine gradually returns to its position. This mode is slow in its steps, but it is successful in its results, even in cases of obstruction and of strangulation. When it fails, it is because of the strength of the adhesions between the cord and the abdominal walls, or the inguinal canal.

(*c*) *Division of the Stricture through the Rectum.*—To perform this operation, invented by Schmidt, a trocar about sixty-five centimeters (some thirty-five inches) long is necessary. This trocar has its point attached with a screw, in order to permit its removal and the substitution of a blunt bistoury. With the left hand in the rectum, a fold of that intestine is secured a little behind the point of stricture, and the trocar pushed through it. The stylet of the instrument being then withdrawn, leaving the canula in place, the point of the trocar for the bistoury is then inserted, while the hand, still in the rectum, leaves the rectal fold loose, feels for the spermatic cord, raises it and guides the bistoury against it, which with comparative ease completes the division of the stricture.

(*d*) *Division of the Stricture after Incision of the Flank.*—Through an incision made in the middle of the right flank, the hand is introduced and grasps the spermatic cord, which is then divided with a bistoury caché, or, which is better, with the inside edge of a hook kept sharp, similar to the hook used in some cases

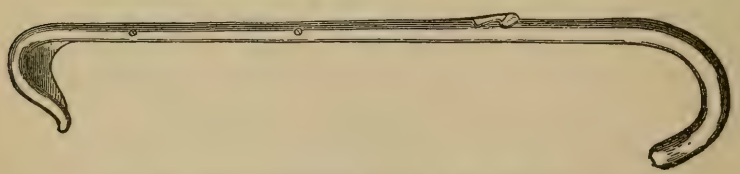


FIG. 390.—Sharp Hook for the Section of the Testicular Cord.

of distokia. The hernia being reduced, and the wound in the flank brought together with sutures, a circular bandage is applied around the abdomen. With the reduction of the hernia, whatever may have been the means of accomplishing it, the symptoms subside, and the treatment is completed by the administration of laxatives or sedatives, rectal injections, etc., as the indications may require.

Umbilical Hernia.

Umbilical hernia is the protrusion through the non-obliterated umbilical ring of either the omentum or the small intestine, or both. It is also known as an *exomphalus* or *omphalocele*. It receives the name of *enteromphalus* or *epiplomphalus* when formed by the displacement of the intestines, or that of the omentum separately, and when both of those organs are implicated it becomes an *entero-epiplomphalus*. Umbilical hernia is quite common in horses and dogs, not less so in bovines, and has been noticed in swine and sheep. It is most common in young animals, especially soon after birth, is at times congenital, and may be long continued, even to adult age, or for eight, ten or twelve years.

Umbilical hernias are either *congenital* or *accidental*. The former are formed during fœtal life and continue at birth, although, according to some authors, they are, strictly, not so much congenital as accidental, and are, in fact, the result of the pulling and stretching of the umbilical cord during the act of delivery. However this may be, they do usually, in fact, make their appearance during the second and third months following birth, when through the persistency of the opening, and the imperfection of the umbilical cicatrix, the intestines are enabled to protrude through the ring, and subsequently to prevent its closing by their presence. But again, while the cicatrix is weak, the active exercise and forcible movements of the young animal while at play may cause the rupture; and still, again, the protrusion may be caused by intestinal derangements. Indeed, all traumatic causes, such as contusions, blows, and any violent efforts taking place during the period of consolidation of the closing cicatricial tissue, may become an originating cause of this lesion. Animals of low and lymphatic constitution are much predisposed to this trouble, especially such as feeble colts, born of mares badly cared for and insufficiently fed during gestation. Heredity fills a large place among the predisposing causes in low-conditioned mares with feeble organizations, and suffering with similar trouble when young, dams of this class naturally bringing forth foals of defective stamina, liable to perpetuate the same constitutional tendencies.

The symptoms of umbilical hernia are generally exclusively local. It is characterized by a semi-globular or pyriform tumor situated on the median line of the abdomen at the umbilical ring,

and varying in dimensions from the size of a hen's egg to that of a child's head—dimensions which may vary according to the condition of vacuity or fullness of the intestine; the position of the animal, whether standing or lying, or according to the length of time it may have existed. The consistency of the tumor is very variable. It may be soft, easily depressed by the finger; elastic, when distended with gases; or soft and puffy when containing alimentary matter—these changes being accounted for by the nature of the organ. An enteromphalus will give the sensation of an elastic mass, while the epiplomphalus will form a puffy swelling. This species of hernia is almost always painless, and exhibits as one of its peculiar and constant symptoms the character of being *reducible*. In the generality of cases, it can be made to disappear temporarily by the taxis and by forcing the protruding portion back into the abdomen, but only to reappear at once as soon as the pressure is withdrawn, especially if the animal is on his feet. On being thus reduced, the opening of the ring can readily be detected, and the fingers may be freely introduced through its diameter and its form and dimensions ascertained, shewing it to be sometimes elliptic, sometimes circular, and sometimes irregular, the originating cause of the hernia itself determining the difference.

Besides these more common symptoms of umbilical hernia, there are others which can be detected by more careful examination. For instance, on applying the hand over the tumor, the vermicular motions of the intestines may be recognized, and by feeling in the hernial sac, the presence of fæcal masses may be discovered; and it may be possible by auscultation even to detect the presence of borborygmus through the displaced intestines, and even to observe its true nature, by reason of the transparency of the sac and its envelopes. These are the most ordinary symptoms of an exomphalus, although it is subject to complications, and the symptomology will vary accordingly.

There are cases, but they are rare, in which the hernia becomes irreducible. The most serious of these are such as are found to have become so in consequence of the formation of adhesions between the protruding organ and the hernial sac—a very infrequent occurrence. The most common cause will be the presence of undigested masses of food accumulated in the intestines, such as hard balls of fæces or sand.

Inflammation of umbilical hernia may follow blows or bruises, though such a result from these accidents is not a common one, and its occurrence will naturally be accompanied with changes in the appearance of the tumor, such as the usual phenomena attending inflammatory action, as increase of temperature, tenderness or pain, œdema, etc., which may even at times so combine their effects as to render the hernia irreducible. Engorgements and *strangulations*, however, are very rare complications of this form of hernia, a fact easily understood when it is considered that the neck of the hernial sac is formed by the umbilical ring itself.

An exomphalus is usually an affection of little gravity, and often disappears spontaneously, or if it persists after the period of weaning, is easily radically cured when the animal grows and develops. Yet even if undisturbed and unchanged, they persist in remaining, their existence is not incompatible with perfect health and full ability to labor, however they may reduce the commercial value of the animal. They are less injurious to young animals than to adults, and less dangerous when small than when assuming large dimensions. When simple, they are easily amenable to treatment, but if complicated they become dangerous, especially so when the capacity of the ring is so disproportioned to the dimensions of the protruding intestines that strangulation becomes an accident of easy occurrence Reducible hernia is attended with but little hazard, while the danger arising from the possible formation of adhesions in cases which have passed into the irreducible class becomes a matter of very serious import.

If it is an admitted fact that animals suffering with umbilical hernia do often recover spontaneously, the recovery being a normal incident of the natural development of the animal, due to changes of position in the abdominal contents, not to specify other efficient causes; then the question of immediate or early interference undoubtedly receives and justifies a negative answer. Our own testimony is that we know of cases where patient waiting, even for a period of twelve months, has been rewarded by the radical disappearance of the hernia. But the objections to such long waiting are of a tangible and serious nature, and surgical interference becomes imperative and indispensable. The persons are few who are able or willing to nurse an idle horse for a year for the sake of saving him from the pain of an operation.

The object of all treatment is, of course, the reduction and retention of the hernia, but the means of doing so are various. They are mainly included under four heads. The first method is by *bandages;* the second, by external or *topical applications;* the third, by *surgical operations* for the *constriction* of the tumor; and the fourth, such special treatment as may be required to meet *complications.*

1st. *Bandages.*—The bandage of retention is essentially a belt buckled around the body, by which a pad is kept over the opening of the umbilicus to prevent the escape of the abdominal contents, and temporarily perform their office in the subcutaneous hernial sac. It is designed to aid in the mechanical closing of the umbilical opening until that takes place by the process of physiological change in the sac and its borders.

The forms of bandage in use are many and various, among which Peuch and Toussaint name four principal kinds. A most important requisite in all of them is that while they possess the solidity and fixity necessary to retain the reduced hernia in place, they shall cause the minimum amount of discomfort to the patient.

The bandage of Marlot, according to Zundel, is the one which best fulfills the three conditions of solidity, fixity and elasticity. It consists of a kind of padded saddle, with straps at its four corners, buckling on two belts, the anterior or *pectoral*, which surrounds the chest like a girth, and the posterior or *ventral*, which presses the retaining pad against the umbilicy. This pad is a wide hair cushion of a moderate thickness, kept in place and prevented from slipping back by a longitudinal girth connecting the pectoral and the ventral belts.

The bandage of Massicra is much recommended in Italy. This also is a small saddle with two wide girths passing under the thorax, and pressing against the sternum and the epigastric region, with a steel band corresponding at its posterior extremity with the umbilical ring, forming a plate padded with a hair cushion.

The apparatus of Strauss, used in Germany, is made somewhat on the same principle, but is reinforced by a kind of breeches which prevents it from slipping backward.

The length of time necessary for a patient to wear a bandage will vary with the dimensions of the hernia—from one to three months, according to Lafosse, being required to obtain a radical cure. Marlot claims that an average of thirty-two days is all that

is necessary. The bandages must be applied only after the perfect reduction of the hernia, and the most accurate adaptation of the pad to the umbilical opening. These appliances are of difficult adjustment and are unavoidably uncomfortable to the animal from their liability to chafe and excoriate the skin. They, therefore, constitute a mode of treatment which must necessarily be attended with uncertainty, and, therefore, as justifying only a careful and modified recommendation. Still, it has in the hands of many practitioners given very satisfactory results.

2d. *Local Applications.*—The treatment by irritating local medication aims to produce in the tissues surrounding the hernial sac an inflammation which will end in a serous infiltration which will crowd away the protruding organ, prevent its return into the opening, and subsequently facilitate the obliteration of both the sac and the ring. This result is obtained by the use of certain chemical agents, which applied on the hernial tumor tend to produce various degrees of inflammation, from simple rubefaction to complete escharification of tissues. In former times sulphuric acid was recommended, and as late as 1833, Hertwig employed it in applications made during two or three days. Blisters and their congeners have had their day. Astringents have also been recommended, as also caustics, principally in the form of ointments, as that of chromate of potash, in the proportion of one part in eight, as recommended by Fœlen—these also have had their advocates. But of all these, nitric acid, applied externally, is the one which has proved most satisfactory and least dangerous.

The treatment consists in applying acid upon the tumor of the exomphalus, in sufficient quantity to produce an escharotic effect, and afterwards promote the sloughing of the cutaneous sac. The mode is thus described: After positive diagnosis of the nature and character of the tumor, the animal being kept in the standing posture, the hairs cut short, the acid is applied over the entire surface of the sac, by rubbing it in with a brush, or a small ball of oakum secured at the end of a stick, and dipped into the acid—which should register 34° to 36° Baume—first passing it circularly over the base of the examphalus to define the place where its action is required, and then including the entire surface. A sufficient quantity of the caustic must be applied, and with enough energy to produce the disorganization of the skin in its entire thickness, and positively produce its mortification. Experience has proved

that the deeper the action of the caustic, the more successful the operation is likely to be. It is said that nearly one ounce of the acid is required for a tumor as large as a man's fist, and that the friction should be continued from three to five minutes. The duration of the friction and the quantity of the acid to be used must, however, be guaged by the dimensions of the tumor, and also with careful consideration of the thickness of the skin. Dayot, to whom is due the positive and practical introduction of this mode of treatment, proposes to apply the acid in instalments, and recommends that the application be repeated once or twice an hour, according to the thickness of the skin, until the desired effect is assured. The result of our own experience is a conviction that as a rule only a single application is necessary. Nitric cauterization produces a yellow eschar, which ordinarily remains for a long time, soft, supple, and unctuous to the touch, but the epidermis of which is easily lacerated. In some cases the formation of the eschar is followed by a large swelling of the cauterized parts and the surrounding tissues. Sometimes it makes its appearance immediately following the operation, but more commonly it appears at a later period, gradually increasing during the first hours following the cautery, although again, in other cases, this swelling is altogether absent The œdema is the direct effect of the action of the caustic upon the subcutaneous cellular tissue, which becomes infiltrated; and in this condition applies a uniform pressure in all directions upon the peritoneal hernial sac, crowding back into the abdominal cavity the displaced intestines and preventing their return by the kind of retentive bandage which is formed by the engorgement which takes place around the sac.

In the days following, after reaching the maximum development, the œdema gradually diminishes by resorption, becoming at the same time somewhat harder, the portions of cauterized skin which is in its center meanwhile gradually drying, and becoming transformed into a dry, hard plate.

In place of the hernia there now remains a fibrous mass of new formation, which gradually diminishes and is soon more or less resorbed. In the meantime, while these phenomena are taking place, the process of the separation of the eschar has begun and progressed, and on the eighth day, on the boundary between the dead and the living structures, a fissure shows itself, and minute granulations appear. The separation goes on slowly, from the

circumference to the center, leaving, when complete, a rose surface, granulating evenly, small fibrous formations sometimes appearing in its center. This wound heals rapidly, leaving a contracted cicatrix, which assists in keeping the hernia in its place, while the indurated skin, which for some time remains adherent to the still fibrous, abdominal, subcutaneous tissue, contributes to the complete obliteration of the ring. After a month the cure is radical, and in place of the hernia, there remains only a hairless cicatrix, often without pigment.

Though this treatment is simple, and has, by the results it has shown, justified the credit it enjoys among those who have had experience and knowledge of its working, it must not be at once accepted as infallible, or unattended with danger. Cases are on record which negative such a claim. For instance, too severe a cauterization may be followed by the entire sloughing of some portion of the abdominal walls, followed by a large eventration; and peritonitis, tetanus and intestinal fistulæ are complications which have sometimes disappointed hopes which seemed to be well founded.

Animals to which this treatment has been applied must be carefully watched for some time during the period following the cauterization. They must be especially prevented from indulging the tendency they often betray—to bite, or scratch with their feet or legs, the irritated, cauterized surface. A cradle or aprons hanging in front of their hind legs, or even bandages may prove effectual to prevent this suicidal habit.

The topical remedies we have mentioned before, might in strictness be considered as coming under the head of external treatment, since they have all been applied to the surface of the skin. There is, howevor another mode of application which is subcutaneous, and which is represented by the method of Dr. Luton, and employed in the treatment of the same ailment in children. It consists in injecting subcutaneously, at each cardinal points of the hernial sac, a few drops of a saturated solution of chlorides of sodium (kitchen salt). We have had but one opportunity to try the value of this treatment, which we improved by injecting ten drops of this solution at each point of a hernial tumor. We produced an enormous swelling, followed after several weeks by resorption and complete disappearance of the hernia. According to Peuch and Toussaint, our friend M. Cagny has

made the same experiment, but failed to obtain a successful result.

3d. *Surgical Operations for the Constriction of the Tumor.*—Modes of surgical treatment are numerous, usually having in view the destruction of the hernial sac, by the process of mortification, so controlled and directed as to bring about the necessary work of adhesion between the walls of the sac, above the line where the mortification begins, with the formation of a secondary cicatrization between the edges of the skin, where the mortified sac has dropped off.

Before casting the animal, without which the operation cannot be performed, the surgeon must satisfy himself that the hernia is reducible, and that there is no adhesion, and should carefully measure the dimensions of the sac in order to know accurately where the constriction must be applied. The animal must be placed well on his back, with his hind quarters elevated—a position which is sometimes sufficient alone to enable the hernia to reduce itself. If that fails to occur, the sac can be evacuated by the taxis. It is then to be well stretched, and the application of the means of constriction proceeded with.

These means are many, but may be considered under the three heads of the *ligature*, the *clamp* and the *suture*—all of which are occasionally combined in use, as the ligature with the suture, or the suture with the clamp.

(*a*) *The Ligature.*—This old mode of operation consists in the application—the hernia having been reduced—of a strong cord, firmly tied at the base of the hernial pouch.

The *modus operandi* is very simple. The hernia being already reduced, either by the taxis or by the power of gravitation, as before mentioned, and the horse in the right position, on his back, the sac is raised from the abdomen, and a strong ligature, firmly tightened, is applied at its base, a strong fishing line forming the best of ligature for this purpose. The degree of tightness of the ligature must be such that the mortification of the sac will be a gradual process, and that it does not slip from the walls of the sac, on account of the progress of the inflammatory swelling. Still this constriction must not be permitted to become so extreme as to produce too rapid a sloughing of the skin, with the possible result of a calamitous eventration.

In order to prevent the displacement of the ligature, some

practitioners recommend the introduction of two small wooden pins just under it, either parallel or crossing each other, through the base of the sac.

If the hernia is very large, instead of employing this mode of simple ligature, *en masse*, the operator may use two ligatures. By pushing through the middle of the sac, close to the abdomen, a dog seton-needle, carrying a doubled cord, and converting it into two parts in cutting it from the needle, each length will serve to embrace half of the tumor, in the manner practiced in the process of removing large, hard tumors by ligature. Legoff has recommended the use of several ligatures dipped into ammonia, placed one above the other upon the whole length of the sac, from its bottom to its base, tightening them more and more as they approach the abdomen. By this process he combined constriction with cauterization.

This mode of treating umbilical hernia is a simple and easy one, but yet it is not very frequently practiced. The uncertainty of its results, the possibility of the sloughing of the skin at too early a period, with the danger of eventration, as well as that of injuring the intestines with the wooden pins or the needle, have all combined to impair its credit and discourage its use among careful operators.

(*b*) *Clamp.*—In this process, which dispenses with the caustic, after the reduction of the hernia, the skin is stretched and pressed between the branches of a wooden clamp or of a specially adapted forceps. The clamp is a simple implement, and may be made with a curve, in which case its convexity is made to adapt itself to that of the abdomen. When applied, it is pressed close to the abdominal walls, and its branches brought together with nippers *adhoc*, and secured with a strong cord, as in the process of castration. The clamp is left on from nine to fifteen days. In many cases, the displacement of the instrument is prevented by using the wooden or metallic pins passed through the skin below it, the ends of the latter being bent over to keep them in place. This operation possesses some great advantages, but offers also some special dangers, among which is the instinctive tendency of the patient to get rid of the irritating appliance by tearing it off.

Another objection to the clamp is found in the danger of causing troublesome excoriations of the sheath by the friction which it necessarily occasions. Benkert and Brogniez have advocated

the use of metallic clamps, but an important objection is found in their weight. Borhauer had the branches of the wooden clamp perforated in several places for the introduction of the pins which held it in place. Bordonnat has invented a special form of metallic clamp or rather forceps, with sharp points on the inner bor-

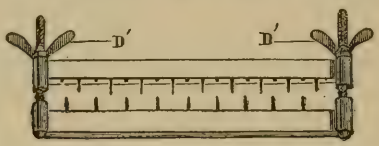


FIG. 391.—Clamp of Bordonnat.

der of one of its branches about one-half or three-quarters of an inch apart, and in the other a corresponding number of holes into which the points are designed to fit when the instrument is closed. Each branch has a prolongation at each end, which on one carries a vertical projection cut with a screw-thread, while in the other there are holes corresponding with the projections, and there are nuts to fit the screws. When the instrument is applied, and the projections passed through the holes, the nuts not only hold it in place, but are adapted to fix the pressure at any desired point, or change it at pleasure. The umbilical forceps of Marlot is made of two small wooden plates, slightly curved lengthwise, and brought together by means of gooves in their dove-tailed extremities, through which screws are fastened. This instrument, like the metallic clamps, is objectionable principally on account of its weight, and is generally less practical than the ordinary clamp.

(*c*) *Sutures.*—These are of various kinds, all agreeing, however, that the stitches upon which they rely shall be so close and tight that the circulation will be so effectually cut off in every part of the hernial sac that mortification cannot fail to follow.

The Quilled Suture.—This consists in placing the sac between two small rods of hard wood or metal, and tying them before and behind with strong cord twisted and rolled around their extremities, and also by passing here and there in their length sutures of double the strength of those which are applied in cases of ordinary quilled suture. Acting somewhat by pressure, this mode much resembles the treatment by the clamp, but is little used at present, notwithstanding some small advantages which it may be thought to possess.

Twisted Sutures.—This consists in applying upon the hernial sac several stitches of strong cord in order to keep the reduced hernia in *statu quo*. It is sometimes used in dogs, but is uncertain and dangerous.

Suture of Delavigne.—This is another dangerous mode of operation, no longer in practice because of the hazard of injury to the intestines. It consists in applying a strong double suture at the base of the sac in the following manner: With a small needle, like that used by harness makers in sewing leather, a thread is passed through and through on both sides of the flat, cutaneous surface from right to left, or *vice versa*, then carried back the reverse way at a small distance from the first puncture, and the sutures firmly tied. This is repeated until the entire sac is included and the sutures have gone beyond the umbilicus. From fifteen to twenty days are said to be sufficient to effect a radical cure.

Method of Mangot.—To make a closing suture on the hernial sac, without danger to the intestine, Mangot has recommended the use of a perforated plate of lead, by which to aid in the retention of the intestines in place and accurately define the line upon which the sutures are to be applied. The plate is made to correspond in dimensions with the opening of the umbilical ring, but somewhat longer and wider. Besides the longitudinal slit in its center, it also has an eye at each corner for the attachment of strings to secure it in place by tying them over the back. The hernia being reduced, and the plate put in place by pushing the skin of the sac through its longitudinal opening, the operator applies a continued suture over and on the outside of the plate to keep it in position, with the flap of sewed skin hanging below it, the entire apparatus being securely attached to the abdominal walls by two pins running through the sac at the extremities of the suture.

During the first days there is much inflammation. About the third or fifth day the pins are removed and the skin below the suture excised, leaving the plate to be retained only by the strings which pass over the back. These are sufficient, however, to keep it in place, and its removal will not be necessary until inflammation is well established all around them. A simple dressing, held in place by a bandage, will help the cicatrization, which is said to take place in from seven to eight days.

Method of Hannon.—The *modus operandi* here indicated does not vary from that of Mangot, except in being modified by the use of the quilled suture, as before described, instead of employing the transversal pins of Mangot.

Method of Mignon.—This is a complex mode, consisting of a combination of the ligature, the clamp and the suture. Like Mangot, he passes the skin through a plate of lead, attaches perforated clamps on the protruding sac below it, and passes the stitches or sutures through the perforations in the clamps.

Method of Benard.—This is strictly speaking, the application of the crossed suture, a stitch exactly resembling that of harness and shoemakers in their respective trades. In making it, a peculiar forceps is used, which is applied like a clamp, and serves not only to keep the sac closed and secured, but also to prevent the return of the intestines into its cavity, and to assist in guiding the two needles with which the suture is made. Its branches are at one end articulated together, and also at the other in order to fit into handles. It is twenty-two centimeters in length, without including the handles; two centimeters in height, and one and a half in thickness. The branches are brought together tightly by a special screw arrangement near the handles, and each has a number of holes, placed regularly, one centimeter apart, and united by a groove. Two strong straight needles and strong waxed thread are required. In operating, the hernia being first reduced, the skin is well stretched

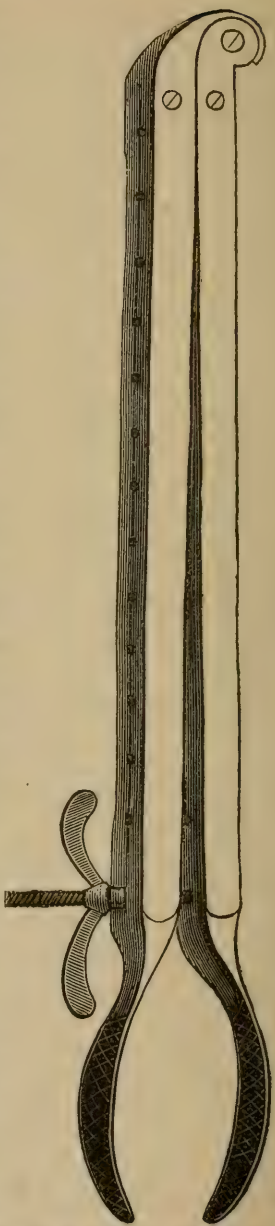


FIG. 392.—Nippers of Benard.

between the branches of the forceps, then these are tightened by the screw management of the handles, and next the instrument is committed to the care of an assistant. The crossed suture is then made by the simultaneous passage of the needles through the holes in the branches of the instrument. The directions to insert the needles simultaneously must not be overlooked. If disregarded, the penalty liable to follow will be the tearing of the waxed thread with the points of the instrument, and also a tangling of the thread. This method gives a stronger ligature than Mangot's, but it lacks the support furnished by the metallic plate.

Method of Marlot.—The methods of Benard and Mangot are here combined. A peculiar thin forceps is used having dotted grooves on its outer surface to indicate where the stitches are to

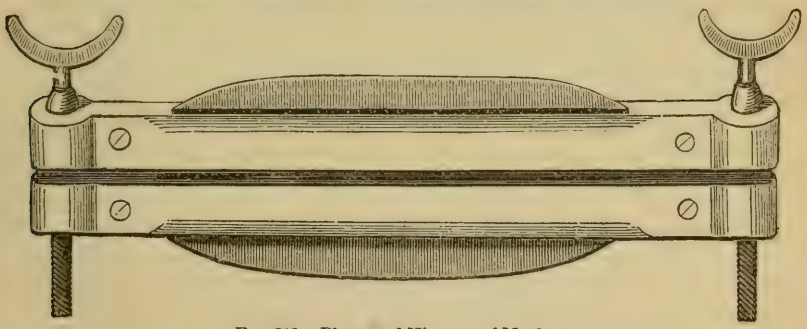


FIG. 393.—Plate and Nippers of Marlow.

be placed. When the suture is finished and the forceps removed a plate of zinc like that of Mangot is applied, as a means of retention, the zinc plate being thought to be an improvement upon that of lead, on account of its adapting itself better to the parts.

Method of Chedhomme.—The animal in this method is kept on his feet, properly secured, and a plate of lead applied, as in the process of Mangot. The hernial sac, folded in two on its longitudinal axis is then passed through the opening of the plate, the operator making the least possible traction until the remaining portion of the umbilical cord, which is still quite large, is firmly held between the thumb and the index finger of the right hand. Then a stronger traction is made upon the sac, at the same time moving it in various directions, while with the left hand the plate is strongly pressed towards the abdominal walls. Then with the intestines entirely replaced, the operator grasps the sac with the

left hand, and with the right, introduces a strong needle which is pushed through and through at each extremity of the sac, and an elastic ligature passed three or four times around its base. Towards the tenth day the slough is completed, and only a small wound remains, which cicatrizes rapidly.

Direct Suture of the umbilical ring.—Director Degive recommends for the treatment of umbilical hernia in young dogs, the direct interrupted sutures of the ring, the number of stitches varying with its dimensions. After bringing the threads together the wound is left open until they have safely eliminated themselves. We have employed this mode of operation for many years in the hospital of the American Veterinary College, using antiseptic precautions, and with the best results. Making a longitudinal line on the median line of the sac, and having carefully pushed back the intestines, the edges of the ring are sewed together with two or three stitches of cat gut ligature. The parts were then thoroughly washed with a solution of bichloride of mercury, and the edges of the skin brought together with silk sutures and a compressing bandage applied for the protection of the wound from the patient's own teeth. Complete cicatrization follows in a few days.

Whatever may be the original mode of treatment the secondary effects are about the same in each case. They consist of irritation of the parts, more or less marked, and betrayed by the patients by varying degrees of restlessness, and possibly, in some cases, by abdominal pain or colics.

After a few hours the swelling of the part begins. A diffused œdema takes place above the point of compression, and the hernial sac is slightly swollen and warm and becomes covered with little phlyctenoids, indicating a commencing necrosis. Perhaps a little fever is manifested and there is great thirst. By the third day the swelling is quite large, and in males it may involve the sheath. The sac then becomes cooler, the fever subsides, the appetite returns, and the animal which has instinctively kept his feet, rests himself by lying down. On the fourth or fifth day the skin of the sac is insensible, cold and flabby, and the sloughing process between the living and the dead skin has begun. Little by little this process becomes more active, and the separation becomes more and more marked, the secretion around its opening a purulent character, and from the sixth to the tenth day the complete sloughing will have taken place. The wound that remains is now granulating.

Its length exceeds its width, and it is somewhat depressed in its center It progresses rapidly towards cicatrization, only a small scar remaining, and this is readily concealed by the growth of the surrounding hair.

(*d*) *Operation in Cases of Complications.*—If the hernia is irreducible and there is strangulation, the enlargement of the ring must be carefully made with a curved, blunt bistoury, having a short, guarded sharp edge. When the reduction is prevented by adhesions, the operation necessary for their division will demand the exercise of the utmost skill and caution to avoid injury of the peritoneum, and there should especially be no neglect or parsimony in respect to the employment of antiseptic precautions. In fact, it would in many instances be wiser to leave the animal to the resources of nature than to undertake an operation of so much delicacy and importance, and which involves so many serious consequences, without amply providing every resource of skill and knowledge, and anticipating every contingency of accident or danger. In some cases, when the strangulation has been due to the formation of gases in the protruding intestine, we have used the aspirator for their removal, and then have met with no difficulty in reducing them by the taxis. This is a means, however, which is also recommended in the treatment of strangulated inguinal hernia, and is discussed in the chapter appropriated to operations in that region.

Diaphragmatic Hernia.

A diaphragmatic hernia, or *diaphragmatocele*, is formed by the displacement of one of the abdominal organs, and its intrusion into the pleural cavities, through a laceration of the diaphragm. It is necessarily an accidental opening, through which such a displacement takes place. One case is on record, and only one, where the hernia passed through a normal opening, viz., the œsophageal.

The causes which give rise to ruptures of this kind may be classified under three heads: first, external violence; second, powerful contraction of the expiratory muscles while making a violent effort; and third, the exertion of force and pressure upon the diaphragm by the organs, situated on its posterior face.

(*a*) *External Violence.*—Foremost in this category are blows or contusions on the posterior costal region, such as may be made

by the shafts of vehicles with either the blunt or broken ends. The laceration of the diaphragm may occur either with or without involving the fracture of the ribs. Several cases of this kind have been seen and recorded by Professor Barrier.

(*b*) *The Powerful Contractions of the Expiratory Muscles during Violent Muscular Efforts.*—It may result from the violent and concentrated action of the abdominal muscles, compressing powerfully the intestinal mass, and crowding it against the diaphragm, until it destroys its continuity at one or more points, sufficiently to admit of the passage of the abdominal organ into the thoracic cavity. Durand has seen it in a six-months-old colt; Didry and Fabey have reported cases where the hernia took place during violent efforts in hauling a load, and Franconi met with a case of a similar character to the one referred to in which the rupture opened into the œsophagus. Schild has seen it associated with the efforts of parturition.

(*c*) *Violent Action and Pressure upon the Diaphragm by the Organs Situated on its Posterior Face.*—The obliquity, forward and downward, of the inferior plane of the abdomen, is shared forward upon the posterior face of the diaphragm by the organs related to it, as the liver, the stomach and the anterior curvatures of the large colon. These are bulky organs, and their united weight being very considerable, the pressure it exerts upon the diaphragm, under any extra impulse would tend directly and naturally to the disruption of the weaker muscular fibres of the midriff, and these yielding, the hernia would immediately become developed, and thus we have the generation of this kind of hernia. A sudden fall might easily bring this to pass, in a second or two of time. Bouley has recorded a case in which this accident occured in an animal cast for a surgical operation. Pilton has seen it take place in an animal falling down while butting against a slope of ground.

Diaphragmatic hernias, like others, are either acute or chronic; or convertibly, recent and free, or of old standing, with adhesions. The distinctions of *hepatocele*, *splenocele*, *stomachocele* and *enterocele* are of but little importance, none of these differences being discoverable in the living animal.

The symptoms of acute hernia of the diaphragm differ, according to the extent of the laceration of the muscle, and the size of the displaced abdominal mass. There are cases in which the in-

jury is of so aggravated a character from the first, that a fatal result immediately follows the formation of the hernia, the only characteristic symptoms present being those of rapid asphyxia. In other cases, though death must inevitably follow, the life of the animal may be prolonged for several hours, or even several days. And again, there are recent hernias which have been formed under such conditions that they are still compatible with the survival of the animal. These assume the chronic character, and not infrequently escape discovery.

The horse affected with diaphragmatic hernia becomes dull, anxious and uneasy, avoiding his manger and avoiding his food. He paws in the stall, giving evidence of suffering from abdominal pains, but which betray no peculiar characteristics, and possess no special or positive significance. Very often colics precede the hernia, and its formation complicating the case, the colics become more violent. During these colics the animal hesitatingly and carefully lies down, rolls much, and assumes various attitudes of no special significance, though the dog-sitting posture is sometimes held to be characteristic. During these colics, which are more persistent than those due to intestinal indigestion, the pulse remain strong and quite regular, and respiration is not only accelerated, but difficult—the physiognomy is anxious, with an expression of apprehended suffocation, the nostrils are tetanically dilated, inspiratory movements are performed with effort, and expiration is of twice or three times its normal frequency. The coexistence of this condition of the respiration with the colics is a sign of great importance as an element of the diagnosis. At times auscultation furnishes valuable data. Borborygmus may be detected in the thorax, where the respiratory murmur ought to be heard, and dullness on percussion takes the place of the normal resonance, where the respiratory murmur has disappeared.

Bouley, though he recommends this means of diagnosticating, considers it to be applicable only for hernias of large size, in which, according to Lafosse, an increase in the size of the thorax, a well marked projection of the cartilaginous circle of the ribs, and together with these, a reduction in the size of the abdomen would be noticed. When the hernia is small, the respiratory function is unaltered.

Acute diaphragmatic hernias, not necessarily of fatal tendency, are more difficult to detect. Probably from their rareness they

often escape discovery, notwithstanding a somewhat positive exhibition of abdominal and thoracic symptoms. And if this is so with the acute form, it must necessarily more frequently occur with chronic cases, which not only do not jeopardise life, but even fail to interfere with the usefulness of the animal. The horse thus affected not only has the double expiration of his emphysematous lungs, but he continues to be subject to intermittent colics, and especially if the hernia is formed by the intestines, and they continue to suffer from occasional obstructions. To this complication of occasional actual obstruction must be added a perpetual liability to become strangulated, with a certainty of speedy death following that accident.

The lesions found at the post-mortem examinations of animals which have died with this description of hernia varies. The accidental diaphragmatic openings may exist in different parts of the central aponeurotic portion or in the peripherical muscular zone, and may assume various forms, being at one time round, at another eliptic or triangular, or indefinite and irregular, at times very narrow, at others so extensive that the abdominal and thoracic cavities are no longer distinct. Between these two extremes there are many degrees and ample scope for the formation of chronic hernias of a non-malignant character. When the hernia is recent and has existed before death, the borders of the laceration whether muscular or aponeurotic, are irregular, thready, infiltrated and bloody, with small blackish clots adhering to the extremities of the red muscular fibres. But when the rupture is of post-mortem formation, resulting from excessive meteorism, there is no trace of capillary hemorrhage upon the lacerated edges of the aperture.

With a chronic hernia these edges have various aspects; at times thin, at others in thick cords; now torn in scallops, and again with a regular edge, they are always smooth, hard, of fibrous consistency, and even presenting a cartilaginous aspect. There is never any formation of a special serous sac for these hernias, even for those which take place through the normal openings. The organs most commonly met in these diaphragmatoceles are the omentum, the small intestines, the anterior curvature of the large colon, and more rarely, the spleen and the stomach. If not congested by pressure in passing through the opening, they continue to perform their functions.

In these injuries the prognosis can never be confidently favor-

able. It is always serious. Some kill immediately, while with others there may be a respite of several hours or days, and with those which are chronic, there may be no apparent impairment of life or health. But whatever may be the character or the aspect of a given case, and however the prognosis may vary, it must never be forgotten that diaphragmatic hernia has this invariable character, that its effect is always to interfere with the respiration; that the horse is at the best permanently affected with heaves, is unable to perform any active or laborious service where strong lungs are needed, and is always more or less liable to engorgement and strangulation. Diaphragmatic hernias are incurable, their situation, in the deepest interior of the anatomy, rendering it impossible to apply any means of direct therapeutic treatment. They cannot be reduced, and even if that were practicable, they could not be secured and retained *in situ*. Attempts have been recommended by Bouley to reduce them by making an incision through the flank and replacing the protruding organ in its proper position by the taxis with the hand in the abdominal cavity. Whether in our days of perfect antiseptics such an operation could be successfully performed on the horse is a question not yet solved. The experiment might be attempted with better chances of success in cattle. In any case the operation will be justifiable only as a last resource, and when the life of the suffering animal is absolutely in jeopardy, in fact, as a final alternative, a *dernier resort*.

Ventral Hernia.

This term includes all hernial tumors produced by the protrusion of one or several of the abdominal organs through an accidental opening in the muscular and fibrous walls of the abdomen, under the skin, which remains intact. The opening through which this kind of rupture takes place is always accidental, unlike those which pass through the natural channels, as the umbilical or inguinal, but still, in common with them, has a peritoneal lining.

Ventral hernias are of quite common occurrence, principally however, in large animals, while in small quadrupeds they occur less frequently, and they may take place in any part of the abdomen. They are known by distinctive names, corresponding with those of the protruding organ, as *gastrocele*, *hepatocele*, *enterocele* and *epiploocele*, etc.

They usually originate as direct causes in blows or contusion

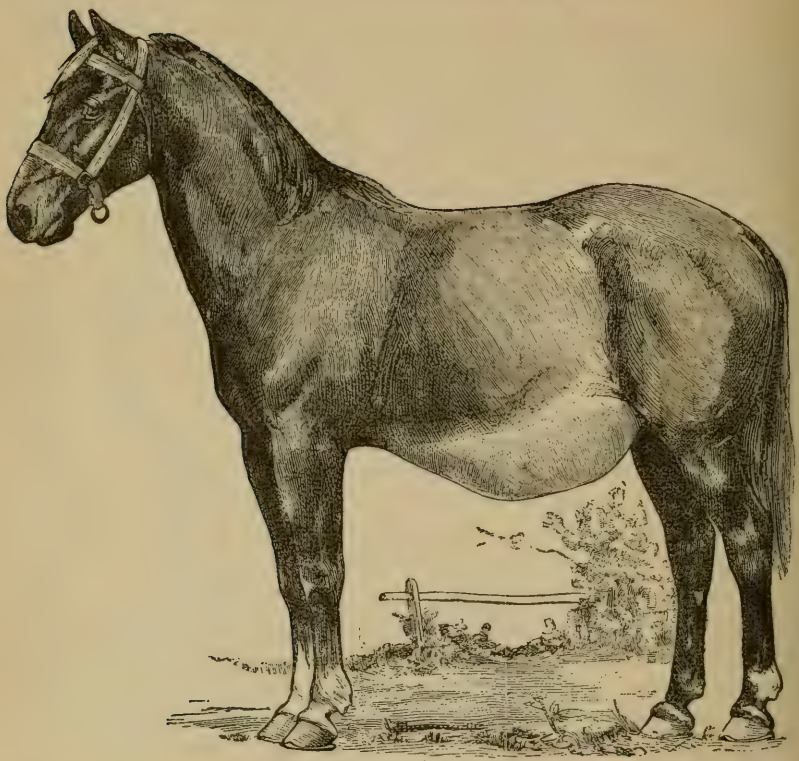


FIG. 394.—Ventral Hernia.

upon the abdominal walls, made by blunt bodies, which, lacking force to pierce through the elastic skin, are yet sufficient to lacerate the interior abdominal walls. An example of this occurs in a thrust from the shaft of a vehicle, or its broken end, in case of a fall, or of kicks or horning among cattle in the field. In colts they are more commonly found in the lower wall of the abdomen, the animal frequently inflicting them upon itself by attempting too high a jump over a picket fence, and failing to clear it properly. Serres says that in cattle they may follow a severe distension of the abdomen under the influence of tympanitis, abdominal dropsy, or gestation.

The character of a case of ventral hernia will vary in respect to its being acute and recent, or chronic and old. Indeed, the lapse of but a few hours will materially change its character from one to the other. If seen immediately after the infliction of the

injury, it is in the form of a round, soft, elastic tumor, well-defined in its outlines, and easily reducible. But if not examined until after a season of delay, the definite configuration disappears, and it is changed into an inflammatory swelling, œdematous, warm and painful to pressure—in fact having the aspect of a warm abscess. In the recent cases, the edges of the torn abdominal walls may be identified through the thickness of the skin, but the surgeon will vainly try to make out this condition if the inflammatory process following the lesion has become established, and the serosity and the blood have become sufficiently infiltrated into the cellular tissue to make the change described. After a few days, if the hernia is not situated too low in the abdomen, the swelling moves downward toward a more dependent spot, and gradually abating disappears in about two weeks. Upon reaching this point, the hernial tumor is once more recognized, constituting, as it does, the exclusive manifestation of the displacement of the intestinal mass, and its presence outside of its natural cavity. It is recognized by its changing conditions—elastic when the intestine is empty; soft and puffy during digestion; by its state of tension, increasing with effort, and by being painless, depressible and reducible. When reduced, the edges of the opening are easily made out, but it is not uncommonly found, upon the subsidence of the inflammatory process, that, during the continuance of that state, adhesions of the protruding organ with the walls of the sac have formed, and the hernia has become irreducible. In their dimensions, ventral hernias vary considerably. They may measure from the size of a large nut to that of a man's head, or even exceed that. Zundel reports a case where the rumen had penetrated into the sac, which hung almost to the ground, and had produced a displacement of the mammæ, crowding them in a mass toward the right side of the abdomen.

Although the diagnosis of ventral hernia is not difficult, it is still not impossible to mistake a recent case for certain other affections of the abdominal walls, such as tumors of bacterian anthrax, or those of a bloody nature, or with phlegmonous or œdematous growths. The reducibility and elasticity of the tumor, the borborygmus, and the presence of the opening through the abdominal walls, are intelligible signs by which to recognize the ventral hernia. Aspiration of the tumor may sometimes be performed, and rectal examination will also be of great assistance provided

the injury is not beyond the reach of exploration with the hand.

Certain complications are not uncommon in ventral hernia. Besides *irreducibility* already mentioned, *excessive inflammation* has sometimes been followed by traumatic peritonitis. *Lacerations* of the displaced organs have proved fatal. *Internal* hemorrhages, fistulas and consecutive eventration have also been recorded. *Strangulation* is not unknown, though it is comparatively rare.

But with all these possibilities, it is not a rare circumstance to meet with animals affected with ventral hernia, even of large dimensions, which have reached a good age with all the appearance of perfect health. From data like these upon which to found a judgment, it ought not to be difficult to deduce a prognosis which should never be far wrong. But, although compatible with the life, health and utilization of the animal, such a lesion must necessarily detract more or less from its commercial value. Under any circumstances, it is a blemish. The least dangerous of this class of ruptures are those which are situated on an elevated point of the abdomen. Recent and uncomplicated, they are amenable to treatment more or less, according to their extent; if old or chronic, the chances of success are reduced; if strangulated, they are generally fatal. Usually, a ventral hernia, to be curable, must be treated when it is recent, and before sufficient time has elapsed for the intestines to become, as it were, accommodated to their new position, and especially before the cicatrization of the borders of the lacerated openings has taken place. Recent and free from complications, all that is required is their reduction and retention in their proper place.

When reduced, whether by rectal taxis or by external pressure, the parts are covered with a mixture of pitch and Venice turpentine melted together, upon which is spread oakum cut in small, short threads, which is to be covered with a second application of the pitch, after which a sheet of pasteboard, itself also impregnated with the pitch mixture, is placed over the opening. The whole is then covered and held in place by a broad bandage carefully rolled around the abdomen. Leather is sometimes used in lieu of the pasteboard. This bandage, when applied upon male bovines, requires to be carefully adapted in order to avoid any possible interference with the penis, and its freedom of motion in the act of micturition. The complications of swelling or bloody

extravasations must not prevent the immediate application of the bandage.

In cases of chronic hernia, compression is no longer sufficient. Jannet recommends the use of clamps as in umbilical hernia, and reports having relieved a case where the tumor was as large as a child's head. Leblanc advises the quilled suture, and Schwanefeld cured by this mode a hernia twice as large as the head of a man. Hertwig speaks favorably of the application of Delavigne's method in exomphalus. Going, Lafosse and Hertwig have obtained success with nitric acid injections, and Krantz and Schutt with blisters. Peyon, Dandrieu, Terrien and Obich have had good results with the direct suture of the ventral walls in bovines, and even solipeds. Bouley objects to the suture of the edges of the opening, and also to injections into the evacuated sac of irritating substances, to excite inflammation and produce the adhesion of its walls. We have ourselves experimented several times with the subcutaneous injections, but every attempt has resulted in failure. According to Peuch & Toussaint, if old ventral hernias are to be treated, the best plan is to have recourse to bandaging, as employed in the treatment of exomphalus.

EVENTRATIONS.

An eventration may be defined as a compound hernia, and it constitutes an accident of the first degree of severity, consisting in the formation of a hernia, of indefinite dimensions, taking place through an opening involving the entire thickness of the abdominal walls, the skin included, in such a manner that some portion of the abdominal viscera, but most commonly the intestines or the omentum, become directly exposed. Ordinarily they are due to some traumatic lesion, such as a thrust from or a fall upon a sharp body, or they may be produced by stab wounds, or punctures with a fork or a knife; or again, by kicks inflicted by other animals, or horn-blows, when cattle are crowded into too contracted a space and struggle for more room, or quarrel when herded in pastures. And they quite commonly end the career of the wretched victims of barbarity which are compelled to assist in the bloody and cruel *sport* of the Spanish bull fight. They are also observed at times following severe surgical manipulations, as in castration, during the operation for strangulated inguinal hernia, after the efforts of

distokia. They may also form one of the complications of some of the forms of the treatment of umbilical hernia. In the smaller animals, such as dogs, they may be produced by a severe bite by a larger animal.

The pathognomonic symptom of an eventration may be considered the protrusion of a portion of the abdominal contents through its lacerated walls. If the opening through which this takes place is small, the viscera will appear as a small round tumor, which presently becomes transformed into a large mass of intestinal circumvolution, which itself varies in dimensions, according to the extent of the laceration. As the exposed intestines begin to protrude, they for a period retain their physiological appearance and normal color, but they undergo rapid changes, becoming progressively darker, blueish and then black, and grow cool to the touch. The viscera as they protrude from the abdomen may be quite intact, but they often are injured, bruised or torn, the conditions varying according to the peculiar circumstances attending the accident. And not only is this so, but the sequel of the case must be especially considered, since an eventration which possibly might be susceptible of cure, if carefully tended from the first, may become so aggravated and exaggerated as to preclude all possibility of remedy, as when the wounded creature, frantic with pain, from colics and otherwise, in rearing and struggling, forces his entrails more and more out of their place, and tears and tramples them upon the earth until they become a mere mass of crushed and bruised viscera, ground into the earth. And yet, colics are not always present in eventrations, even in horses whose irritable temper, combined with the condition of the injured parts, would naturally tend to render their occurrence quite inevitable.

The prognosis of their injuries varies according to the species of the animal, and also under the special condition and circumstances of each case, as judged by itself. In horses, it is, in the majority of cases, a fatal accident. The sensitiveness of the animal to impressions upon the nerves, and the delicate susceptibility of the peritoneum account for this. In ruminants they are less serious, and certainly still less so in carnivorous animals, where sometimes the whole intestinal mass may be seen hanging through the laceration, and with extensive co-existing inflammation, without the occurrence of a fatal termination.

Swine are also very sensitive to this kind of injury, though the

prognosis may vary with them, according to the condition of the lesion, being more or less favorable according as the bulk of the protruding viscera is less or greater. The chances of recovery will also vary in the ratio of the degree of the exposure of the visceral organs to the atmospheric air, or to the severity of any traumatic accidents they may have encountered.

The indications of treatment suggested in these cases is obvious. The first is always, when practicable, *reduction*. To return the intestine to the situation designed by nature for its occupancy is the first step to take. If it has not been seriously wounded, and is in a state of cleanliness, and has escaped contact with the earth and other soils and stains, simple washing may be attended to at once. But if, on the contrary, it is bruised, soiled and inflamed, it must be carefully cleansed with warm water, before being returned to its position. This reduction must be carefully performed by the taxis, and if the opening of the abdomen is too small to allow this to be accomplished with facility, it will be good practice to enlarge the opening with the knife, rather than to hazard the too free manipulation of the tender parts which will form the dangerous alternative which may become the exciting causes of consecutive inflammatory, and perhaps gangrenous sequelæ. If instead of the intestines the eventration allows the exit of the omentum, this also must be cleaned and washed, if necessary, and returned, though in some instances it may be torn or cut off after ligating its large blood vessels, or better yet, ligating the whole mass with animal ligature. The second step of the operation consists in applying means of restraint to retain the returned organ and prevent a second exit. The quilled suture is at this juncture the means which always first suggests itself to the surgeon's mind. The clamps have their advocates, but Zundel prefers the metallic interrupted sutures. The entire application is to be supported, reenforced and protected by a wide bandage, similar to some of those recommended in umbilical hernia.

LAPAROTOMY.

This operation, which consists in the opening of the abdominal cavity through the loins or flanks, is one which, considering the general indication for which it is performed in human surgery, has found but little application and occupies but a small place in

veterinary practice. According to Director Degives, who furnishes the only description of the operation to which we have been able to obtain access, the indication for laparotomy occurs in cases of intestinal invagination, internal hernia and intestinal strangulation and for the removal of foreign bodies from the abdominal cavity or the intestinal tract.

Once a celebrated surgeon of New York had decided to practice it upon one of his valuable dogs, which was suffering with impaction caused by the lodgement of a mass of hair in the intestines, which we fortunately succeeded in softening and removing by internal treatment. The indications for the operation are imperative as soon as a fatal result becomes imminent and certain. The instruments necessary are a convex bistoury and suture needles.

Dr. Degives briefly describes the operation as follows: "*Position* and *Restraint* of the animal standing up, or in stocks, or resting against a wall or its equivalent. If the animal is restless let him be thrown down on the side opposite to that of the operation, which is divided into three steps.

First Step, opening of the flank.—The abdominal opening must be in the upper part of the flank, upon a line between the hip and the last rib. This opening may be made in two ways:

1st, or *Simple Method.*—It consists in making an incision through the various anatomical layers, in the same direction, in order to form a simple vertical wound, large enough to admit the hand. The parts having been shaved, the division of the skin, the abdominal muscles and the peritoneum is made successively with the convex bistoury. The incision of the deep layers alone presents any difficulty, and this requires some attention, the hemorrhage being sometimes troublesome; but when the peritoneum is exposed, the incision is increased, from without inward, with either a blunt bistoury or the straight bistoury controlled by a grooved director, an assistant protecting the intestines from the contact of the instrument.

2d, or *New Method*, by *Complex Incision.*—In this each muscle is divided in the direction of its own proper fibres. Thus, the first is a transverse, cutaneous incision; second, three muscular divisions, running in directions more or less opposed to each other; the first, obliquely downward and backward; the second, obliquely forward and downward, and the third transversal and parallel to that of the skin. These incisions are very easily made,

little more being necessary than a simple laceration of the intestinal tissue with the fingers—there is little or no hemorrhage. The opening thus made admits the hand into the abdomen, and when it is removed the fibres of each muscle having a tendency to come together spontaneously, the opening is more or less effectually closed.

Second step.—This varies, to correspond with the object of the operation; 1st, whether the extraction of a foreign body in the abdomen or intestines, or 2d, the reduction of an invagination or of an internal hernia (diaphragmatic, mesentoric, epiploic, or pancreatic), and, 3d, the displacement or removal of a tumor involving the intestines.

In the reduction of an internal hernia, it may be necessary either to pull or to push upon the displaced organ. In some cases the hernial ring must be enlarged, and if that cannot be done with the fingers, the bistoury must be used. The reduction of an intestinal invagination is obtained by the combined action of a slight traction on the invaginated part and a steady external pressure upon the enlargement formed by it in the portion of the intestines in which it is enfolded. When the swelling of the organs or the presence of abnormal adhesions prevent the reduction, the traction must be increased and in opposite directions—the invaginated portion in one, the enfolded portion in the opposite.

If a stone, a calculus, or any foreign body is to be extracted, the intestine is to be incised at some distance from the insertion of the mesentery, on its lateral face, between the two curvatures. On the removal of the body the intestinal suture is to be applied.

Third step, Closing the Parietal Wound.—When the complex incision has been made, a strong cutaneous suture is all that is required. When the division has been a simple one, the edges of the muscular wound are brought together by ordinary interrupted sutures, and the skin is afterward sewed up. The drainage at the lower part of the wound is always advantageous."

As enteritis and peritonitis are common sequelæ of this operation much care and watchfulness devolve on the surgeon in directing the regimen and nursing of the patient in order to prevent the possibility of their access from becoming a certainty.

CHAPTER IX.

OPERATIONS ON THE RESPIRATORY APPARATUS.

ON THE GUTTURAL POUCHES—HYOVERTEBROTOMY.

This term fails to meet the approval of Zundel, who has proposed that of *Hyospondylotomy* as a substitute, in order the better to indicate the puncture of the sac of the guttural pouches which it signifies. The former name, however, has been generally accepted, and while its etymology would point to the operation by which the puncture referred to is made between the hyoid bone and the atlas, it is still used to mean generally, the puncture of the pouches, at whatever point it may be made.

These guttural pouches, which exist exclusively in the solipeds, and are two in number, are situated between the cranium, the pharynx and the atlas, resting upon each other on the median line, each one, by an expansion of the mucous membrane of the Eustachian tubes, forming a sac and filling the triangular space situated posterior to the pharynx and extending to the larynx. The mucous membrane which forms them is easily stretched, and the cavity may thus become greatly distended by the accumulation of pus, and when this is the case, the pouch extends below the larynx and the lower extremity of that organ. Thus situated in the parotid region, these two sacs sustain important relations to other points, varying according to the position, whether of extension or flexion, of the head upon the neck, and are covered by seven separate tissues, as represented in their order from without inward, by 1st, the skin; 2d, a layer of subcutaneous connective tissue, more or less abundant; 3d, a thin expansion of cutaneous muscle with the parotido-auricularis muscle; 4th, the parotid gland, whose internal face is moulded upon the muscles and blood vessels underneath; 5th, the following muscles in the order as named from above downward, viz., the small oblique of the head—the stylo-hyoideus, which fills the space left between the anterior border of

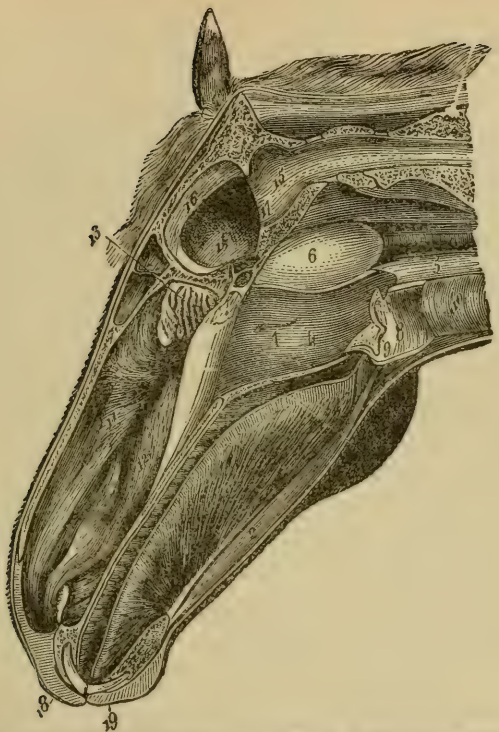


FIG. 395.—Antero-Posterior Section of the Head, showing the Mouth, Fances, and Nasal Cavities.

1, genio-glossus muscle; 2, genio-hyoideus muscle; 3, the velum palati; 4, pharyngeal cavity; 5, œsophagus; 6, guttural pouches; 7, pharyngeal opening of the Eustachian tube; 8, laryngeal cavity; 9, lateral ventricle of the larynx; 10, trachea; 11, ethmoidal turbinated; 12, maxillary turbinated; 13, ethmoidal volutes; 14, cerebral compartment of the cranian cavity; 15, cerebellar compartment of the same; 16, falx cerebri; 17, tentorium cerebelli; 18, superior lip; 19, inferior lip.

the styloid process of the occipital bone and the superior border of the long branch of the hyoid, through which the puncture is made in order to enter the guttural pouches, and back of this the stylo-hyoideus and the superior border of the digastricus; then, 6th, on the deepest layer, the guttural pouches are found superiorly, resting intimately on the internal face of the stylo-hyoideus muscle, inferiorly closely cemented with the posterior face of the pharynx and posteriorly with the superior extremity of the long muscle of the neck; and 7th, the numerous and important blood vessels and nerves belonging to the parotid region.

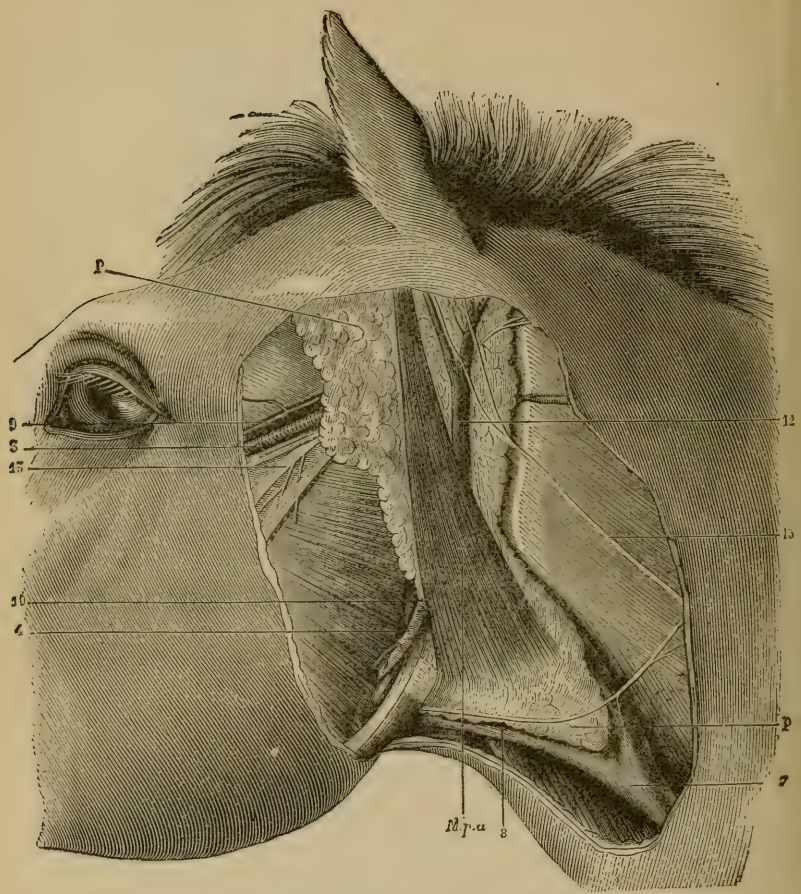


FIG. 397.—Parotid Region—Superficial Layer.

P P, parotid gland; Mpa, parotido-auricular muscle; 3, transveral artery of the face; 4, maxillo-muscular vein; 7, jugular vein; 8, glosso-facial vein; 9, transversal vein of the face; 10, maxillo-muscular vein; 12, posterior auricular vein; 13, facial nerve; 15, auricular branch of the 2d cervical pair.

The arteries are the three divisions of the primitive carotid; 1st, the occipital, which, by its mastoid branch, runs over the external surface of the styloid process of the occipital bone; 2d, the internal carotid, which runs upward through the thickness of the fold of the mucous membrane which forms the guttural sacs; 3d, the external carotid, with its parotid branches, the maxillo-muscular, the posterior auricular, the superficial temporal trunk and the internal maxillary. The veins, which are numerous, empty

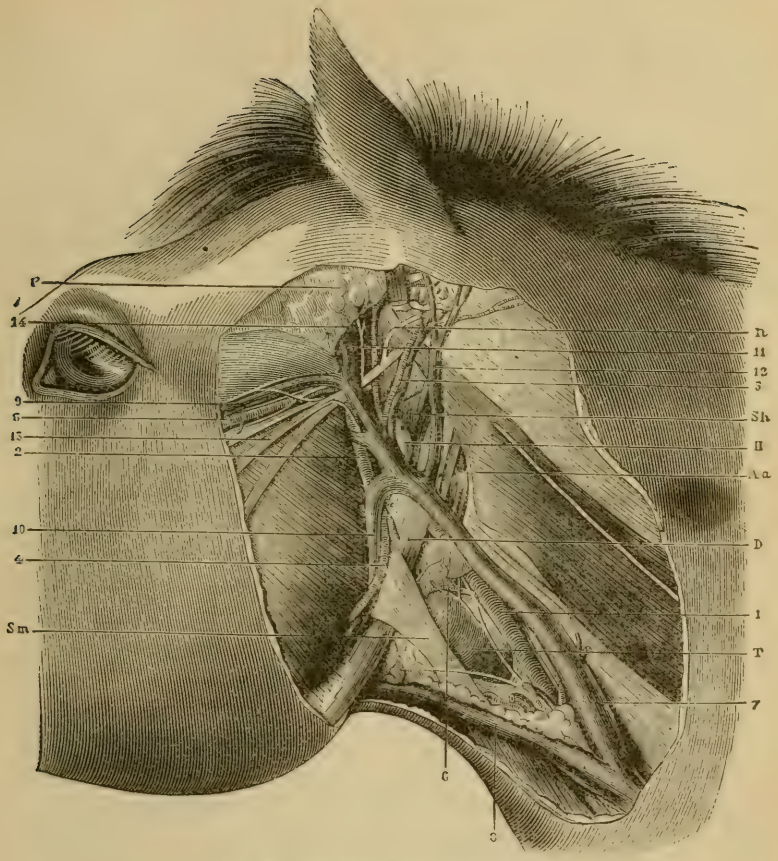


FIG. 397.—Parotid Region—Middle Layer.

P, parotid gland; D, digastricus muscle; Sh, occipito, or stylo-hyoideus, muscle; Sm, sterno-maxillaris muscle; P, thyroid gland; H, posterior border of the great branch of the hyoid bone; 1, primitive carotid artery; 2, external carotid artery; 3, transversal artery of the face; 4, maxillo-muscular artery; 5, posterior auricular artery; 6, thyro-laryngeal artery; 7, jugular vein; 8, glosso-facial vein; 9, transversal vein of the face; 10, maxillo-muscular vein; 11, anterior auricular vein; 12, posterior auricular vein; 13, facial nerves; 14, anterior auricular nerve.

into the jugular or its different branches. The principal nerves of the parotid region are the facial, the pneumogastric, the spinal, the superior cervical ganglion of the sympathetic, the great hypoglossus and the glosso-pharyngeal. These nerves, with the exception of the facial, are situated on the external face of the pouches below the long branch of the hyoid bone and the stylo-hyoideus.

This rapid summary of the anatomy of the parotid region will sufficiently indicate the dangers which the surgeon is likely to encounter at successive steps of the operation, and especially if he duly considers the location of the occipito-hyoideus, which must be reached before the puncture can be made, and again, the peculiar course followed by the posterior auricular artery as it emerges from the parotid to reach its destination.

Hyovertebrotomy is indicated in all cases of repletion of the guttural pouches resulting from a purulent collection and maintained by a process of chronic inflammation. It is principally when horses have become liable to be attacked with strangles that these purulent collections are formed. They are marked by an increase of size in the pouches, gradually augmenting with the continued formation of the pus, and interfering more and more with deglutition and respiration, sometimes assuming such proportions as even to threaten suffocation. Attacks of pharyngitis or laryngitis, or catarrh of the anterior chambers of the respiratory apparatus and nasal cavities, or sinuses, are at times noticed in connection with this affection.

To revert to the anatomical arrangement of the parts: The guttural pouches, opening into the cavity of the pharynx by a narrow slit, are situated on the lateral surface, and thus allow any collection of pus they may contain to flow without interruption into the pharynx,and hence into the other nasal cavities. We have here an explanation of the fact that a discharge from the nose in any one of a variety of affections, such as suppuration of the guttural pouches, pharyngitis, laryngitis, catarrh, and also the discharge of glanders, may all possess different characteristics, and each exhibit a different aspect, and therefore demand a different diagnosis and require different treatment.

The discharge from the guttural pouches is whitish, glairy, more or less mixed with mucosities, inodorous, non-adhesive to the wing of the nose, and intermittent, being marked during mastication or deglutition, and especially while swallowing liquids—in all forming an assemblage of characteristics which should be sufficient to distinguish the affection from all others. There is, besides this, a negative point, in the absence of chancres, which with the distinct nature and peculiarity of the discharge, and the characters so typical of the maxillary lymphatic glands in that disease, will largely aid in determining the difference between the two affections.

In respect to glanders, moreover, the bad odor, the thick, grumous nasal discharge, and the soreness and dullness on percussion of certain parts of the face, will in many cases serve to identify and distinguish a pathological condition of the sinuses very different from that of the disease we are considering. Gohier and Vatel also refer to guttural tympanitis, or dilatation of the pouches by air, as a feature of their disordered condition. The amount of pus collected in the pouches varies in different cases to such an extent that from only a trifling degree of dilatation it may be sufficiently extensive to produce a sensible projection of the sac below the parotid. This dilation furnishes a guide for the determination of the proper point at which to make the puncture, whether in the upper, in the middle, or in the lower part of the pouches. The upper operation is hyovertebrotomy proper. Besides these three modes of operation, Gunther has proposed a fourth method which consists in penetrating the pouches through the nasal cavities.

Upper operation—Hyovertebrotomy proper.—As described by Chabert and Fromage de Feugré, this is one of the finest and most delicate operations of veterinary surgery. Extremely so when performed on horses whose pouches are healthy and normal in size, it loses a great deal of its apparent difficulty when these are full of pus with prominent and well developed walls. The nerves and blood vessels which surround them are then easily pushed aside from their position, and the lobules of the parotid are more or less separated.

The instruments required for this operation are: a pair of scissors, a convex and a straight bistoury, a dissecting forceps, an

FIG. 398.—Curved Trocar, or Hyovertebrotome.

S probe, or preferably, the curved trocar, the hyovertebrotome (Fig. 398), and a piece of tape. Artery forceps and ligatures ought to be always within reach.

Bouley, Zundel and others recommend that the animal should be kept in the standing position with simply a twitch on the lip,

but our experience has taught us that the recumbent position is the safest, especially if there are plenty of assistants at hand, with instructions to keep the head of the animal steady, and in a moderate state of extension on the neck.

The operation is divided into three steps; 1st, *The incision of the skin and dissection of the parotid;* 2d, *The puncture of the pouch through the occipito-hyoideus muscle;* and 3d, *The establishment of the counter-opening.*

Before considering these three steps, it will be well to answer sundry important questions put by Lecoq in the first good description of the operation, made in 1841.

Where shall the puncture be made?

The anatomical disposition, which we have already examined, suggests as an answer to this query, that the *occipito-hyoideus muscle* is the proper place for the puncture. Its inner side is lined with the mucous membrane of the pouches, and as has already been remarked, when this is distended by fluid and becomes tense and resisting, it is in a much better condition for the passage of the knife through its thickness than when flabby and soft, and therefore movable and shifting, as if endeavoring to evade the knife. At any other point the pouches are so surrounded by important blood vessels and nerves that the operation is precluded by the danger which would be incurred by attempting it.

Where must the first incision be made to reach the occipito-hyoideus muscle?

It would be easy to reach the muscle by a division of the parotid gland, but this would involve the formation of a fistula, and a wound difficult to heal, to avoid which the gland must be raised out of the way. This should be done by raising the posterior border, where it is loose and free from blood vessels or nerves of importance, in preference to doing so by disturbing the anterior border or superior extremity, where the posterior auricular artery, the facial nerve and the sub-zygomatic artery are situated. The superior extremity of the incision must begin near the inferior border of the tendon common to the splenius and small complexus muscles, a little in front of the transverse border of the atlas, and extend downward for a space of two or three inches.

Upon what point of the muscle must the puncture be made?

The answer to this is—upon the central portion of the muscle. The introduction of the bistoury into the superior part of the

muscle will involve possible danger to the posterior auricular artery, and the risk of the division of the facial nerve.

In what direction must the sharp edge of the bistoury be turned?

The reply to this is the *point of minimum danger* from irregular motions of the instrument, caused by the struggling of the patient; and this result is most likely to be accomplished by carrying the bistoury towards the tuberosity of the hyoid bone, and consequently in the direction of the patient's nose. With the instrument turned towards the ear, there would be possible danger of dividing the posterior auricular artery, the facial nerve or, perhaps, the internal carotid.

In carrying it toward the atlas, the internal carotid, and the nerves surrounding it, would be the endangered parts, if any. If directed downward, toward the larynx, a division of the great hypoglossus, and possibly of the external carotid, might be possible.

What must be the direction of the instrument?

If the bistoury is pushed through the occipito-hyoideus muscle, and in a direction perpendicular to it, there will be great danger, at a certain depth, of reaching and penetrating through the internal carotid artery; but if an oblique direction be given to the instrument, not only is this danger avoided, but no accident beyond some slight muscular injury, of no importance, need be apprehended.

Where is the counter-opening to be made?

The right place will be the most dependent part of the pouches, and the instrument used must be either the S probe or the trocar, as will be hereafter described.

These preliminary points being understood, we shall the more intelligently follow the description of the three steps of the operation, which we now proceed to give.

1st. *The Incision of the Skin and Dissection of the Posterior Border of the Parotid.*—This incision is made a little in front of the transverse process of the atlas. It includes the skin and some subcutaneous aponeurotic fibres, and extends to the posterior border of the parotid, which is at this point exposed. With the straight bistoury and dissecting forceps, the parotid border is dissected, and under it the aponeurosis of the levator-humeri is divided. The finger is then pushed between the aponeurosis and the small oblique muscle of the head, in order to reach the occipito-

hyoideus, which is readily identified by feeling for the styloid process of the occipital bone and the superior border of the long branch of the hyoid. Some little hemorrhage and some struggling of the patient may follow this incision, caused by the division of the auricular vein and nerve, but the consequences will not be serious.

2d. *Puncture of the Pouch through the Muscle.*—The central point of the muscle being identified, the operator, with a straight bistoury held in the manner of a writing-pen, introduces it under the parotid, obliquely, from above downward, and from behind forward, and thus divides the muscle through and through, and penetrates the pouch. If the puncture proves to be sufficiently large, the index finger is introduced into the opening for exploration, and, if necessary, for its further dilatation.

If the collection of pus is not very abundant, and the mucous membrane lining the sac not greatly distended, it will be important to have a very sharp-pointed instrument, which will make its work of incision sure, instead of merely pushing the membrane away from the internal face of the muscle—an accident which might lead to serious results.

But again, when the collection is abundant and the pouches much distended, the use of the bistoury may prove unnecessary, the puncture being then readily made by pushing the index finger through both the muscle and the mucous membrane of the pouch.

3d. *Making a Counter-Opening.*—The S probe, or curved trocar (Fig. 398), is introduced through the opening made, and is pushed down to the bottom of the pouch, where the mucous membrane is easily torn; it is then carefully directed toward a point a little below the glosso-facial branch of the jugular, back of the thick border of the maxillary bone, and pushing against it with sufficient force, the instrument forms a prominent point under the skin. If the S probe is used, an incision is made with the bistoury through the skin, and the instrument is exposed. If the curved trocar, it is by a strong pushing movement passed through the skin and brought outside. Whatever instrument may be used, a piece of tape or kind of seton is introduced from the lower through the upper opening, and the continued escape of pus thus facilitated and ensured. The extremities of this piece of tape are secured together by tying them with the knot used with the ordinary seton.

The attention required by the patients after the operation is of the simplest kind, consisting in keeping the wounded surface thoroughly clean and keeping up the flow of the pus This will at first make its escape through the upper opening, but will soon find its way through the lower one, and so long as it is discharging the opening must not be allowed to close, nor must the seton be moved.

Puncture in the Middle and the Lower Regions of the Parotid.—These modes of operation are so nearly identical that, with H. Bouley, we think they may with propriety be jointly considered.

In these cases but little attention to the anatomy of the part is required. The growth of the purulent collection distends the pouches, displaces the blood vessels and nerves, separates them more or less from the parotid, and becomes more superficial, and, in fact, may ulcerate through the skin and empty itself spontaneously. But this process is a very slow, tedious and painful one, and subjects the patient to such a degree of suffering, that it becomes a duty imperative to interpose the resources of surgery for its relief.

The puncture in this case should be made as early as possible, and at the fluctuating point, as with an ordinary abscess. It is made with the bistoury, or, what would be better, with the olivary actual cautery, by which the prevention of hemorrhage will be assured. The opening thus made and cauterized, will, moreover, have less tendency to close too rapidly, besides which the modifying effects of the cauterization will have a highly advantageous influence upon the healing process.

The opening of the pouch at its lower extremity has been recommended when the purulent collection is small, or when concretions of inspissated pus are supposed to exist in the cavities. It is done by first dissecting the wide and thin lower portion of the parotido-auricularis, then of the base of the parotid, under which the distended pouch is seen and punctured.

We remember a case where the collection in both cavities was such that we had no difficulty in opening them on each side of the neck, about on a level with the thyroid glands, the lower operation with emphasis!

Puncture Through the Eustachian Tubes.—Gunther has invented a tube, rounded at one extremity, a sort of hollow bougie,

which he introduces into the guttural pouches by passing it through the nasal cavities and the Eustachian tubes. Although in performing this operation the animal is thrown down, it is very difficult to accomplish, and requires to be preceded by the operation of tracheotomy. It also requires to be repeated several times, by reason of the liability of the collection to return.

The mode of operation is a matter of no importance, since the solutions of continuity resulting from it seldom assumes a form more serious than that of an ordinary simple wound, and requiring no special directions as to treatment. Even ordinary detergent washes are scarcely necessary.

LARYNGOTOMY—ARYTENECTOMY.

The history of surgical interference at the larynx, to relieve the peculiar difficulty of respiration known as roaring, depending upon paralysis of the laryngeal muscles, dates as far back as 1845, when Professor Gunther, of Hanover, attempted, in succession, *the resection of the vocal cords, the removal of the vocal cord of the paralyzed side of the larynx, the partial excision of the arytenoid cartilage, the entire extirpation of that cartilage, the removal of the vocal cord and of the corresponding laryngeal ventricule*, and finally *the fixation of the arytenoid, by an anchylosis at its articulation with the thyroid cartilage.* The results obtained by Gunther were more or less successful.

These experiments were repeated by Gerlach, H. Bouley, Stockfelth and Bassi, but subsequently repudiated and ignored. But in later years Professor Moller, of Berlin, and George Fleming, of London, have turned their attention to the subject, with the suggestion of various new modes of operating, which have yielded results more or less encouraging. The matter has been followed up by other veterinarians in various parts of the world, and recently especially by Professor Cadiot, and the successes which have been recorded, though not always perfect, seem to justify the prosecution of further inquiries and new trials for the relief of a disease which has thus far baffled the skill of veterinarians, and consigned many a valuable animal to the hands of the knacker.

The operation of Professor Moller, also recommended by Professor Cadiot, as at present practiced, is the excision of the paralyzed cartilage. That of George Fleming is the removal of the

cartilage and the vocal cord. We shall describe the Fleming and Cadiot modes as we find them recorded in their own works, "Roaring in Horses," by the former, and "The Surgical Treatment of Chronic Roaring," by the latter.

The Fleming Method.—The special instruments necessary are small ordinary forceps; scalpels; bull-dog forceps; tracheal

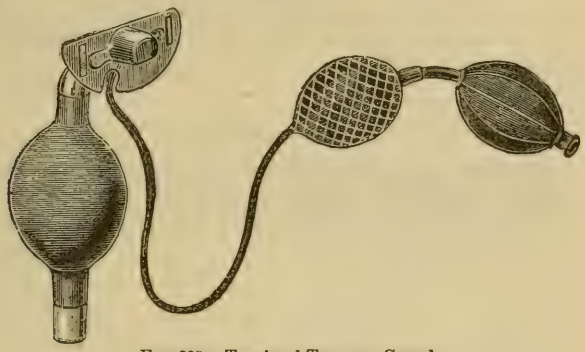


FIG. 399.—Tracheal Tampon Canula.

tampon; a canula, formed of a long tracheotomy tube, with an india rubber bag surrounding its middle. This bag is inflated by means of an india-rubber air-pump, after the insertion of the tube into the trachea, and is useful in preventing the flow of blood into the bronchii during the horse's getting up after the operation, and for half an hour subsequently. Other instruments required are a razor-shaped knife, with which to excise the cartilage; a bent knife with which to remove the muscles from the outside of the arytenoid cartilage; a hook to seize and raise the lower end of

FIG. 400.—Razor-shaped Knife.

FIG. 401.—Bent Knife.

FIG. 402.—Hook to Secure the Cartilage.

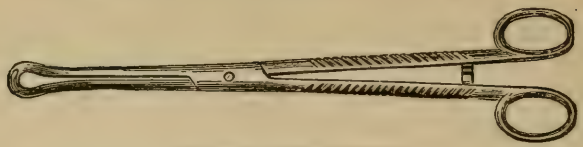


FIG. 403.—Special Forceps.

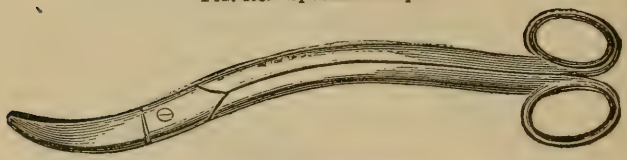


FIG. 404.—Curved Scissors.

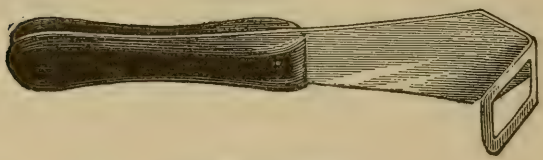


FIG. 405.—Retractor.

FIG. 406.—Electric Lamp.

the cartilage; a special forceps with toothed ends, to seize the body of the cartilage; curved scissors to cut through the mucous membrane; two retractors to keep the trachea opened during the operation; and an electric lamp to illuminate the interior of the larynx.

Fleming describes the operation as follows: "The horse should be well fed for a day or two preceding the operation, but have little or no food or drink for some hours before its actual performance. In the case of thoroughbred horses, a dose of four ounces of tincture of opium in a pint of water, half an hour before operating, is advisable. The hair must be removed closely from around the upper part of the trachea and larynx, before the

animal is cast, and he is thrown in the usual manner, on a good bed of straw or moss or litter. The chloroform bag is put on, and when the required state of narcosis is induced, the animal is placed on his back, and maintained there by sacks filled with straw, placed close under each side of the body. The neck and head are extended in a line with the body, the head placed on the vertex and kept steady by an assistant. The operator places himself in a kneeling position, on the off, or right side of the body, if right handed, beside the neck, with his back to the shoulder and face toward the head."

The operation is divided into three stages:

First Stage.—"With a scalpel, an incision of from four to six inches in length is made through the skin, the middle line of the larynx and trachea, opposite the posterior border of the lower jaw, extending from the body of the thyroid cartilage to the second or third tracheal ring. This exposes the subscapulo-hyoid, sterno-hyoid and sterno-thyroid muscles, which are incised to the same extent, and as close as possible to their line of junction (*raphe*) in the middle, the section being then carried through to the larynx and trachea. There is a variable amount of hemorrhage now to contend with, which, if only oozing, may be checked by sponging it dry until the blood has ceased to flow; and if it comes from twigs of arteries or veins, they may be seized, and twisted, or ligated."

Second Stage.—"The middle crico-thyroid ligament, cricoid cartilage, and one, two or three tracheal rings are cut through, in a straight line, exposing the interior of the larynx and trachea. If blood vessels are cut, they should be taken up. A retractor is applied to the sides, and these being pulled gently apart by an assistant, there is ample space in which to manipulate. The convex lower border of the arytenoid on each side can now be seen, and if the respiration is deep, that which is next the operator (the right), will be observed to move actively from the side toward the middle; while if the roaring is due to paralysis of the left dilator muscle, there is no movement in the opposite cartilage. When the breathing is very tranquil, which is often the case, the right cartilage moves almost imperceptibly, and it becomes necessary to ascertain whether the left one is really immovable. This can be done by passing the finger, or a long probe, up toward the epiglottis, when the act of swallowing will be excited, during which

the right arytenoid cartilage is energetically jerked into the middle of the cavity; but the left one is either motionless or only feebly stirs, depending upon the degree of the wasting of the constrictor muscles on that side.

"If any blood lodges in the trachea, it can be removed by large or small (handled) sponges, which may be passed to the operator by an assistant who receives and washes them. As the horse is now breathing through the wound, the chloroform bag may be removed.

"It is always advisable to examine the interior of the larynx carefully, in order to ascertain its exact condition, as there may be something more in the case than an immovable cartilage. For this purpose the electric lamp is invaluable.

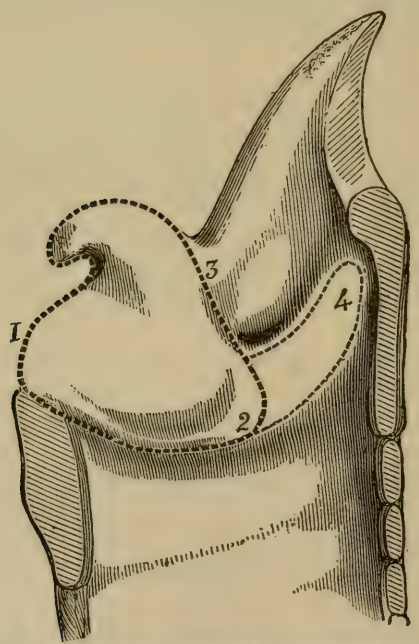


FIG. 407.—Left Side Section of Larynx, showing the Parts excised in the Operation for Roaring.

"The left arytenoid cartilage may be excised by commencing at the lower convex border, or at the upper part, where it meets the right cartilage (Fig. 407). If the latter method is selected, then a cut with a razor-shaped knife is made through the mucous

membrane, into the arytenoid ligament and arytenoid muscle, as close to the margin of the cartilage as possible, beginning between the cartilage of Santorini, downward and then upward and the vocal process at the insertion of the vocal cord (Fig. 407). The hook is inserted in the vocal process, which is raised, and the vocal cord is separated from the cartilage by the scissors; then the muscles on the outside of the cartilage are cut with the bent knife, or, what is better, pushed from its surface as close as possible. The hook is removed, and the body of the cartilage seized with the rachet forceps. The mucous membrane connecting the cartilage with the vocal pouch is divided, with the curved scissors, cutting as close to the cartilage as possible, to save the membrane.

"The arytenoid cartilage is now free, except at its articulation with the cricoid, and it may either be disarticulated or cut through with the scalpel at this point, care being taken to leave no loose portions or shreds. The cartilage being now only retained by the soft parts at the upper portion (or base of the arytenoid cartilage), these are cut through, close to it, with the scissors, when it is altogether detached.

"Care must be taken to avoid wounding the other cartilages, or the pharyngeal mucous membrane, and to spare that membrane in proximity to the arytenoid cartilage as much as possible, removing only that which covers its surface and the cartilage of Santorini.

"The vocal cord is now removed close to its attachment to the thyroid cartilage, in front and at its fixed border (Fig. 407). This can be done with the scissors, a finger being passed to the bottom of the ventricle to facilitate the excision; or the cord may be drawn from the side by inserting a hook in it, to allow plenty of room for the scissors.

"If the hemorrhage is troublesome, which it seldom is, the blood can be mopped out of the trachea with the sponges. It cannot pass down that tube, owing to the position of the neck. If necessary, the electric lamp may be employed to ascertain how the operation has been performed, or even during it performance; but after a little experience this is unnecessary."

Third Stage.—"The trachea being completely freed from blood, and the tampon canula introduced, the bag being inflated after it has been properly placed into the trachea by means of the air-pump, the canula is secured in position by a tape around the

neck. It is only required for about half an hour, until the hemorrhage has ceased, as it will prevent the entrance of blood into the lungs while the horse is getting up, and for a short time afterward respiration being carried on through the tube. It ought not to be left any longer, being liable to injure the interior of the trachea. The blood being again removed from the larynx, one or two syringe-fulls of the common salt or borax solution are injected into it and the pharynx. This washes out these cavities and the sinuses of the head, a necessary precaution, as putrefying blood in them sometimes gives rise to troublesome consequences. Swallowing should be induced by touching the epiglottis, and then the horse may be turned on his side, the lower margin of the wound being depressed, to allow the remaining blood and water to flow out. This completes the operation.

"The horse is now allowed to recover from the chloroform, and when ready he may be assisted to get upon his feet, care being taken that the canula is not displaced while doing so. The wound is kept open with the finger for a short time, to allow any remaining blood to escape, and it is afterward cleansed away from around the wound, the face and nostrils sponged to refresh the patient, and if the weather is cold, the body clothed and the legs bandaged."

Method of Cadiot.—The special instruments required are a

FIG. 408.—Blunt Bistoury.

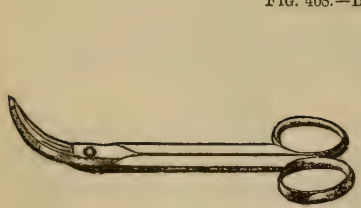


FIG. 409.—Curved Scissors.

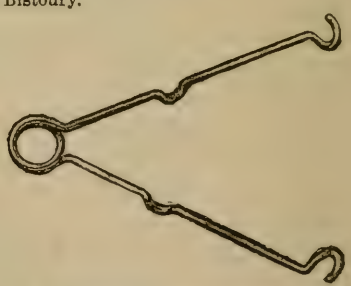


FIG. 410.—Spring Tenaculum, or Dilator.

blunt bistoury, curved scissors, whose blades are nearly perpendicular to the branches, a spring tenaculum, a hooked or long bull-dog forceps, a canula tampon, like that used by Fleming, a

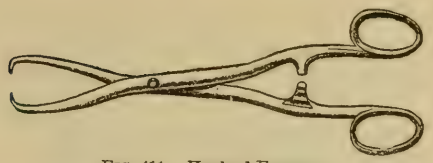


FIG. 411.—Hooked Forceps.

peculiar curved needle, shown in Figure 418, straight, long and ordinary curved scissors, bistouries, dissecting forceps, artery nippers, loose and fixed sponges, thread, cotton, pheniated or iodoformed gauze, and antiseptic solutions.

The preparation of the animal is similar to that in Fleming's method.

First Stage.—Incision of the Skin and Muscles covering the Larynx.—The incision must be made on the median line, and extend from the body of the thyroid to the second or third tracheal ring. This is done with the convex bistoury, first dividing the skin in its whole length, when the edges separating show the raphe of the sterno-hyoid and omoplat-hyoideus muscles. The muscular layer can then be divided exactly upon the median line. The division of the prelaryngeal connective tissue closes the first stage. The hemorrhage is always light and easily controlled.

Second Stage.—Incision of the Larnyx and of the First Two Rings of the Trachea, Introduction and Fixation of the Canula.—The incision may be made by a single stroke of the knife, dividing the crico-thyroid, and with it, successively, the cricoid and the crico-tracheal ligaments, and the first rings of the trachea. But by this mode of operation, the vocal cords may be injured, and to avoid this, the bistoury held perfectly vertical, with the edge turned backward, is inserted through the crico-thyroid ligament, immediately in front of the cricoid cartilage, and this is divided with the crico-tracheal ligament, as well as the first ring of the trachea. The edges of the laryngo-tracheal incision are then opened with the spreaders, or the spring tenaculum, and the division of the thyro-cricoid ligament is completed, from behind forward, and from within outward. As by the act of inspiration the vocal cords move more or less outward, this movement should be carefully watched while making the incision of the crico-thyroid membranes to save them from injury. The canula-tampon is then introduced, and when in place, is moderately inflated by an assistant, the operator measuring the degree of dila-

tation with his fingers in the superior part of the trachea. When it is sufficiently expanded, a ligature is applied upon the India rubber tube, and this is cut off. Though the tampon is inflated,

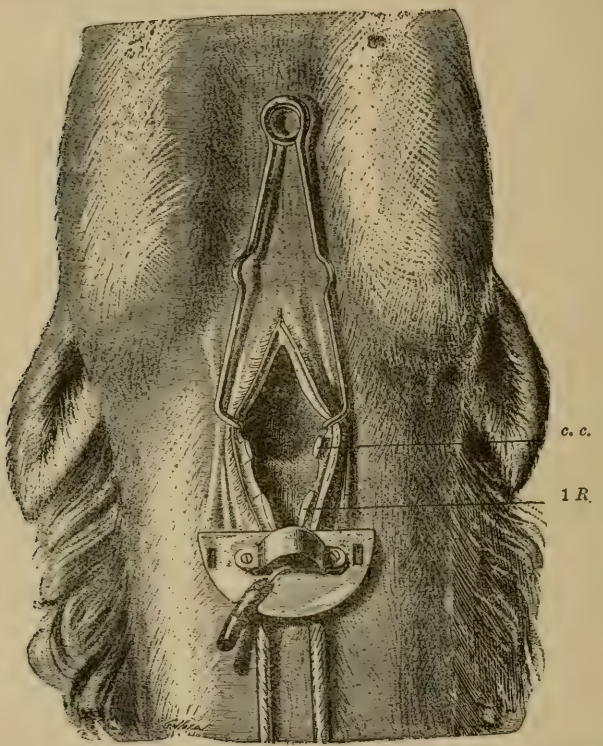


FIG. 412.—Arytenectomy. The *second step* is over. The crico-thyroid ligament, cricoid cartilage, crico-tracheal ligament and the two first tracheal rings are divided. The canula and the tenaculum are in place—*c c*, Cricoid Cartilage. *1 R*, First Ring of the Trachea.

the canula has a tendency to slip in the larynx, and for the prevention of this accident should be secured by bands or strings tied backward over the neck.

Third Stage.—Ablation of the Arytenoid Cartilage.—The ablation of the cartilage is effected by several steps:

(*a*) *Incision of the Mucous Membrane along the Superior and Posterior Borders of the Cartilage.*—With a blunt bistoury and a slight pressure, an incision is made in the mucous membrane along the side of the superior and posterior borders of the

arytenoid (see Fig. 413), the instrument being then carried into the larynx on the median line, from before backward to the cricoid, and thence from within outward and from below upward, as far as the insertion of the vocal cord. To save the mucous mem-

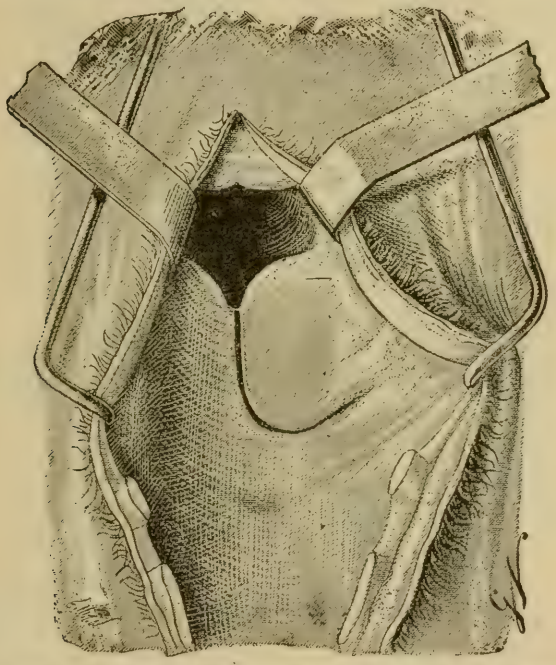


FIG. 413.—*3d Step.* *a*, Incision of the Mucous Membrane along the Superior and Posterior Borders of the Arytenoid.

brane, the incision may be made at some distance from the borders of the cartilage, but the division of the membrane must be complete.

(*b*) *Section of the Vocal Cord; Dissection of the Cartilage on its Inferior and Anterior Borders and External Face.*—With long, sharp, straight scissors, the vocal cord is excised at its insertion upon the arytenoid (see Fig. 414). The cartilage is then, by small nips of the scissors, made from behind forward, dissected in dividing the mucous membrane along its inferior border, and the muscular fibres of the crico-arytenoid and thyro-arytenoid, inserted on its external face (Fig. 415); the mucous membrane, which covers the anterior border, being divided from above

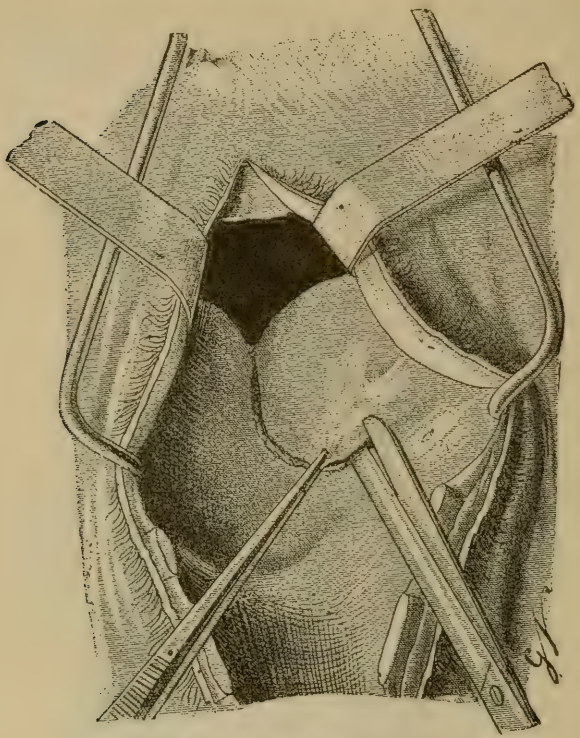


FIG. 414.—*3d Step.* *b*, Section of the Vocal Cord.

downward with the scissors. To facilitate this part of the operation, the cartilage must be firmly held with either the hooked or the bull-dog forceps, and carried toward the median line, when the inferior border and the external face are dissected, and drawn backward and upward when the dissection goes on, on the anterior border. The only important or particular caution needed here, is to hold the point of the scissors always in contact with the cartilage, to keep close to it, to save the mucous membrane, and to avoid the laryngeal ventricle as well as the tissues loosened from the external face of the cartilage. Toward the end of this third step, when the cartilage is separated from the fibres of the thyro-arytenoid muscle, a hemorrhage takes place from the divided laryngeal branch of the thyroid artery (Fig. 416). This must be controlled by torsion or artery nippers.

(*c*) *Section of the Cartilage near its Articulation with the*

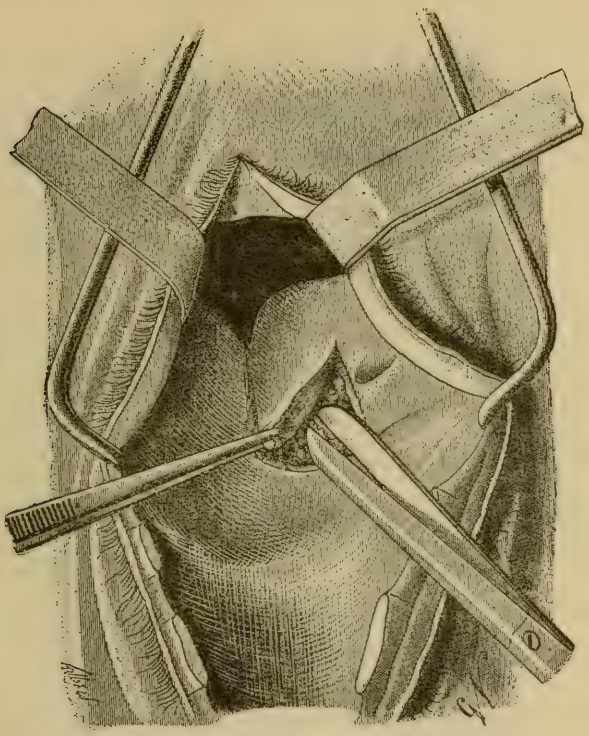


FIG. 415.—*3d Step.* *b*, Dissection of the Arytenoid at its Inferior Border and its External Face.

Cricoid.—Raised and immobilized with a strong forceps, or the hook forceps, held with the left hand, the arytenoid is separated from without inward near its postero-superior angle, the articular, with the blunt bistoury. Held in a vertical direction, or somewhat obliquely downward and forward, the bistoury is moved toward the external part of the arytenoid, immediately in front of the cricoid, and the section is made by a limited and careful sawing motion. When the arytenoid is partially ossified, which is a condition encountered in nearly one half of the patients, some force may be used. A feeling of cessation of resistance, and an increased mobility of the cartilage, indicates the completion of the section.

(*d*) *Dissection of the Cartilage by its Superior Face* (Fig. 417). —This is done with the curved scissors. The cartilage being well

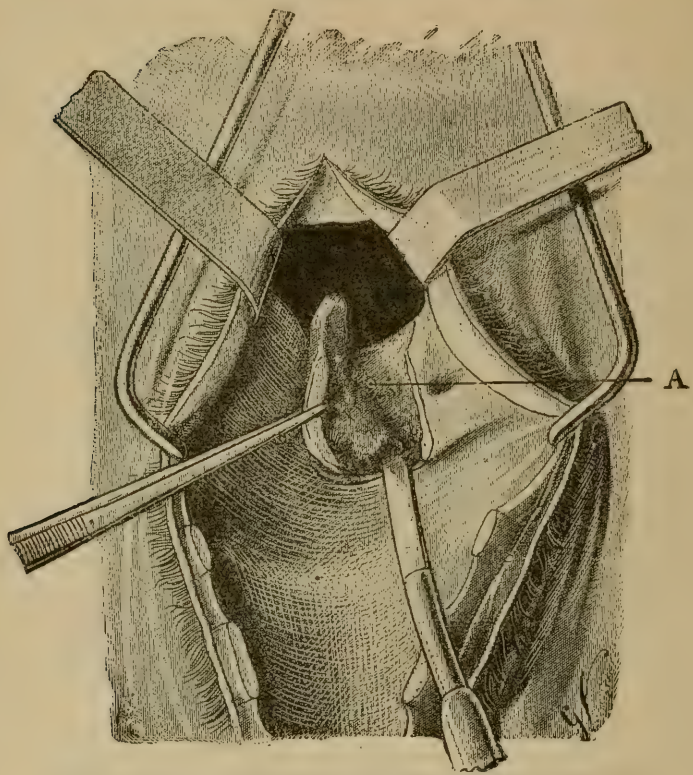


FIG. 416.—*3d Step.* *c*, Section of the Arytenoid near its Articular Angle. *A*, Laryngeal Branch of the Thyro-Laryngeal Artery.

raised with the forceps, the scissors are introduced under its posterior portion, with the branches held almost vertically, and close to the cartilage, from behind forward, and the fibres of the arytenoid muscle are nipped off. With careful attention, the perfect dissection of the entire cartilage, including its beak, may be effected. During this part of the operation, blood and pharyngeal mucosities may interfere with the manipulations, and must be removed with pieces of soft cloth, wadding or sponges.

When these various manipulations have been well executed as described, the surface left by the loss of substance presents a neat and smooth appearance, not only on its borders, but over its entire extent. Professor Cadiot, in this step of the operation, omits the excision of the vocal cord, which he considers unnecessary.

Fourth Stage. Suture.—The borders of the wound are brought

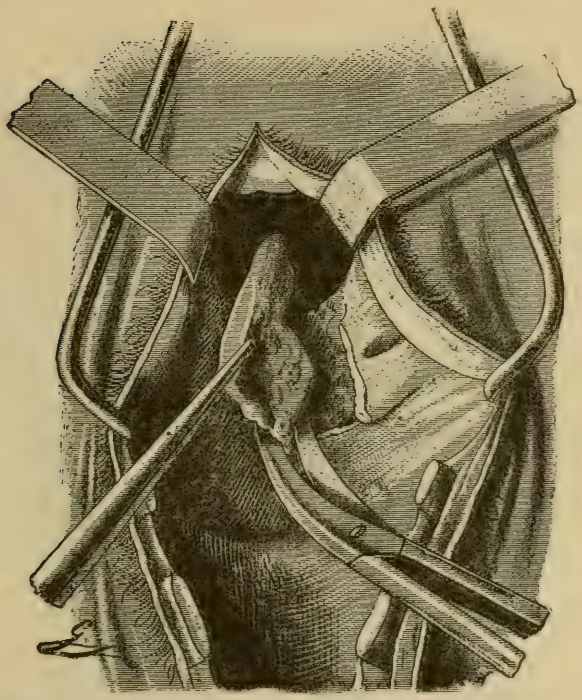


FIG. 417.—*3d Step.* *d*, Excision of the Cartilage with the Curved Scissors.

together with two or three interrupted catgut sutures, made with a special needle (Fig. 418). Three of these are generally required (Fig. 419).

After cleansing the larynx of the blood, it is dressed with wadding or iodoformed gauze. The edges of the external wound are brought together by two interrupted sutures, one upon the muscular coat, the other on the skin, the latter being so placed as to prevent the displacement of the canula.

The care of the wound, aside from the matters of cleanliness and the application of antiseptic measures, varies according to the two modes of operation. But they agree in advising the early removal of the canula at a period not later than the day following that of the operation.

Careful diet is indicated, but Fleming advises strict fasting from both food and water for two or three days, while Cadiot permits the animal to have his ordinary diet without interruption.

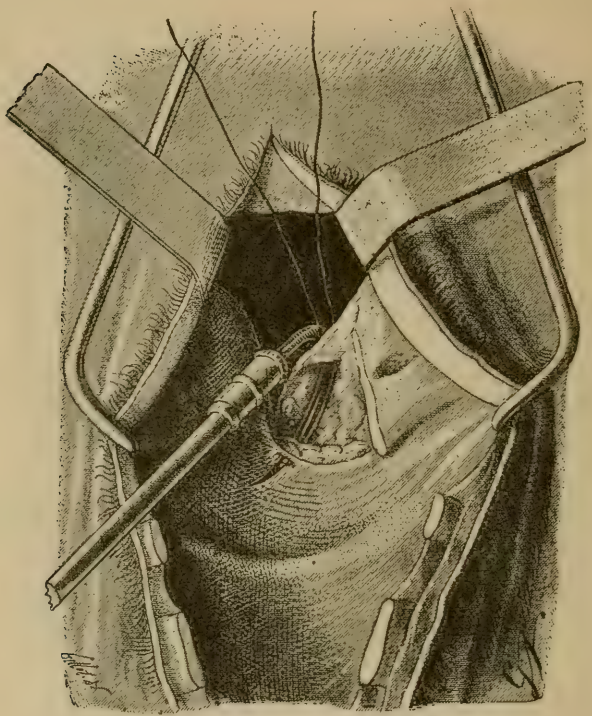


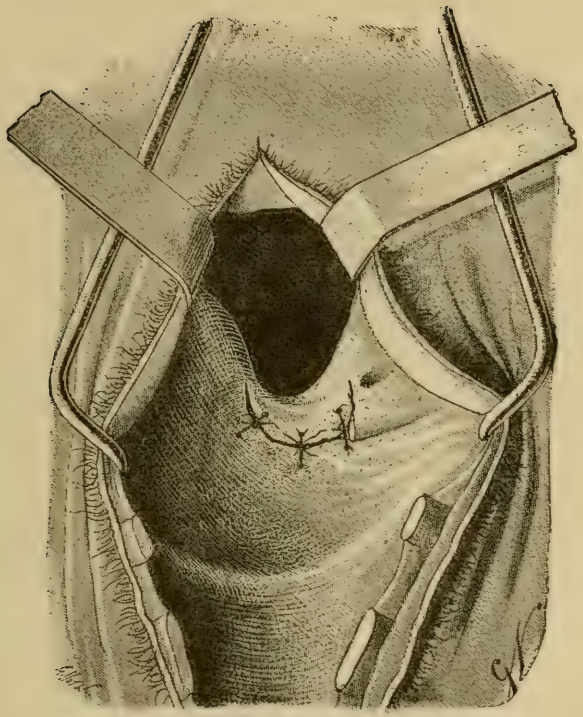
FIG. 418.—*4th Step.* How to Apply the Sutures.

There is no serious febrile reaction, and after three or four weeks the cicatrization is complete.

The result of the operation cannot be fully ascertained until about three months after the operation, when the animal can be tested.

The application of the sutures constitutes an improvement, we believe, on Fleming's operations for assisting the cicatrization of the laryngeal wound, which, however, can be more easily watched if the external sutures recommended by Cadiot are dispensed with. Excessive granulations, when detected, must be cauterized with chloride of zinc or nitrate of silver.

Among the accidents and complications that may follow arytenectomy, and which are mentioned by Fleming and Cadiot, are wounds of the mucous membrane and of the arytenoid left in the larynx, incomplete deglution of the dressing, pneumonia from



GIG. 419.—The Sutures are in Place; three are necessary.

foreign bodies, excessive granulations of the cicatrix, pyemia, tetanus, besides those which result from the division of the cartilaginous structure, such as deformity of the tracheal rings, and the contraction of the tracheal diameter.

TRACHEOTOMY.

This term represents an operation consisting in making a methodic opening of varying dimensions, in the cervical position of the trachea, in order to provide a free channel for the atmospheric air into the respiratory tract. Its ultimate object is either the removal of foreign bodies, or of the abnormal growth from the larynx, or to facilitate the passage of the air necessary to respiration. Its subjects are principally the large domestic animals, more especially the horse, and it has also been employed with advantage on ruminants, and often successfully on dogs.

The importance of the operation, with its utility, is readily demonstrated by studying the effect of its performance, and estimating the relief which immediately follows, in some special cases of ailment or accidents, complicated with the danger of imminently impending suffocation. It is performed in the middle of the inferior border of the neck, in that portion where the trachea

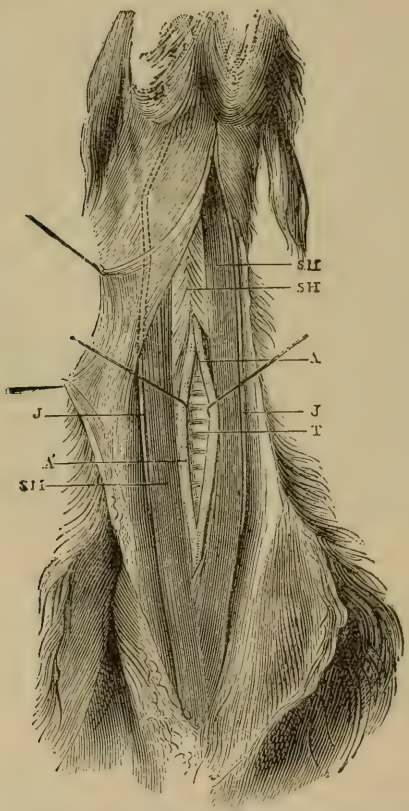


FIG. 520.—Tracheal Region. *T*, Trachea; *A A*, Sterno-Hyoideus and Thyroideus Muscles; *S H*, Sub-Scapulo-Hyoideus; *S M*, Sterno-Maxillaris; *J*, Jugular Vein.

being most subcutaneous, can be readily felt, in the lozenge formed by the diverging branches of the sterno-maxillary muscles below, and the two converging sub-scapulo-hyoideus above. The trachea is here merely covered by the subcutaneous band of the sterno-hyoideus and sterno-thyroideus, and the whole is wrapped

by the thin expansion of the cutaneous colli. In this middle third of the neck, the cartilaginous rings of the trachea, with the ligaments between which unite them, are readily identified.

The indications of tracheotomy, which are quite numerous, are enumerated by Zundel, under five principal heads: 1st, when an obstacle exists which interferes with the free access of air to the lung, as in case of contraction or obstruction of any portion of the air passages, including all the diseases of the upper part of the respiratory tract, and acting directly, such as acute laryngitis, œdema of the glottis, and polypi or paralysis of the larynx; or together with those which act indirectly, as strangles, purulent collections in the guttural pouches, anasarca and purpura hemorrhagica; 2d, when foreign bodies have become lodged in the fauces or the larynx, in order to facilitate their extraction, either directly, by means of special forceps, or indirectly, by pushing them back into the mouth to enable the surgeon to grasp them with his hand; 3d, to remove tumors, polypi, cysts or cancerous growths; 4th, in cases of fractures of the bones of the face, of the cartilages of the larynx, or of the trachea; and 5th, again, when the trachea has become the seat of any specific lesions, such as tracheocele; caries of the tracheal cartilages, or of deformities, such as may result from fractures, ossifications and contractions.

The operation is, however, contra-indicated when the cause or object which impedes respiration occupies a point so low in the passage as to be beyond reach by the tracheotomy tube; or when the difficulty in breathing and the danger of suffocation are due to a diseased condition, either of the lungs or of the heart.

The instruments required for the operation are: a pair of curved scissors, a convex and a pointed bistoury, a sharp-pointed tenaculum, a bull-dog forceps, two blunt tenaculums and a trach eotomy tube. Some special instruments for the division and amputation of the trachea have been invented, but the tracheotomes, as they are called, do not generally serve as good a purpose as the ordinary instruments already named.

Tracheotomy tubes are of various forms and devices. Some are of very simple construction, and others are more or less complicated. The ordinary tube consists of a bent and curved canula, made of various diameters, more or less cylindrical, and secured on a square plate, nearly flat, or with a curve in order to adapt it to the convexity of the neck, and with an eyelet or

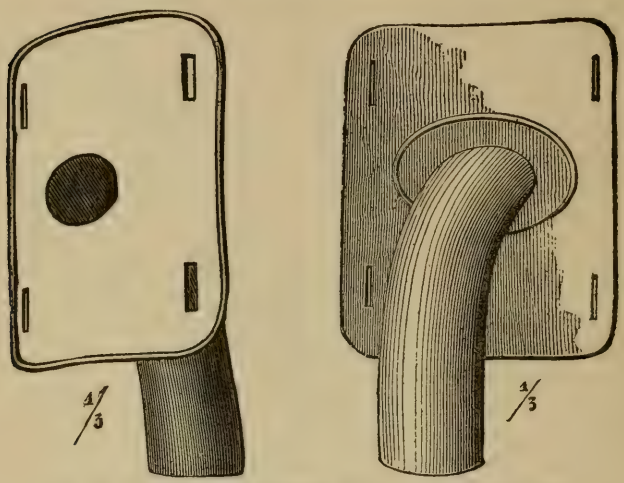


FIG. 421.—Ordinary Tracheotomy Tube, front and back view.

slit at each corner, for the attachment of bands or straps. These tubes are generally made of silver or nickel-plated metal, though gutta percha is the material sometimes used, its lack of solidity, however, rendering the instruments composed of it uncertain and dangerous. Besides this ordinary tube, there is a long catalogue of others, among which we have those invented by Dieterichs, Gowing, Spooner, Vachette, Pradat, Brogniez, Leblanc, Renault, Peuch, Imlin, Trasbot, and these do not exhaust the list. But among all this host of instruments of this class there is probably none which fulfils its purpose better than that of Director Degives, somewhat modified by Professor Peuch (Fig. 430), which, by its simplicity, and especially from the fact of its being a self-holder, has proved itself to be the most convenient of all for general practice. When once inserted and adjusted, this tube may be left in place without danger of removal or dropping of itself, while the ordinary tube, which requires to be secured by strings tied over the neck, can never be as safe as the self-retaining instruments, which hold themselves.

There are two methods of performing the operation, one of which may be called the *classical*, and the other the *immediate* method. In the former, two adjoining tracheal rings are divided, and removed, in part or totally; in the latter, a longitudinal incision is made through the rings without loss of substance (Fig. 433). In

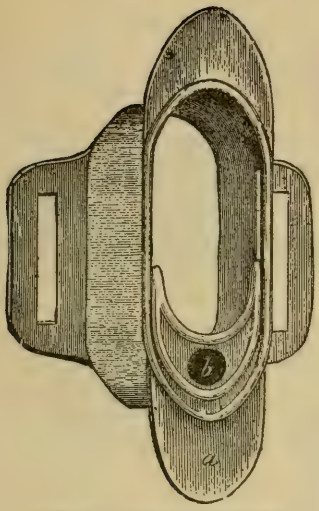


FIG. 422.—Tube of Dieterichs; posterior view.

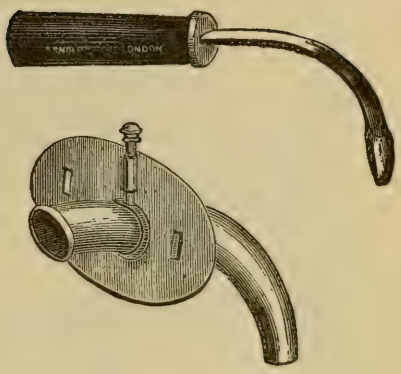


FIG. 423.—Gowing's Tracheotomy Tube.

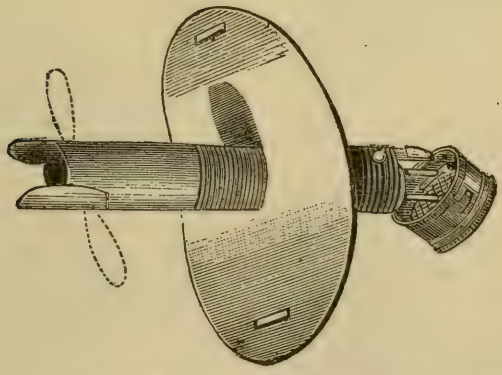


FIG. 424.—Spooner's Tracheotomy Tube.

either case the animal is, if possible, kept on his feet, with the head elevated by a twitch applied on the lower lip. It may sometimes be necessary to place him in stocks; to hobble his fore legs, or perhaps only to raise one of the fore feet. In some instances the patient is unable to stand, and, in fact, is already down when the surgeon is called, and this is probably one of the only conditions when the longitudinal incision is fully justified.

Classical Method.—This includes three steps, the object of

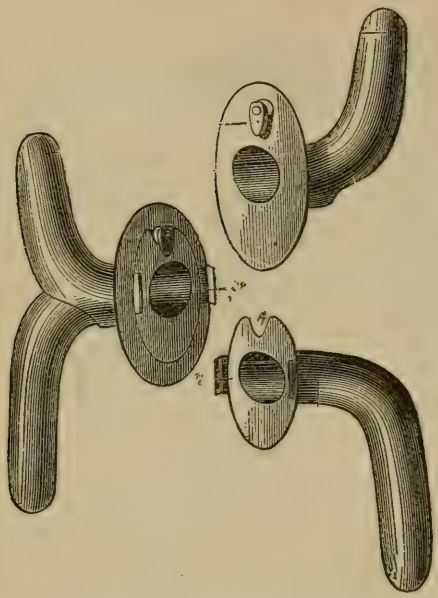


FIG. 425.—Vachette's Tube.

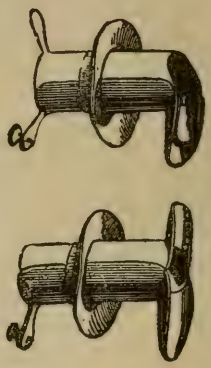


FIG. 426.—Tube of Pradat.

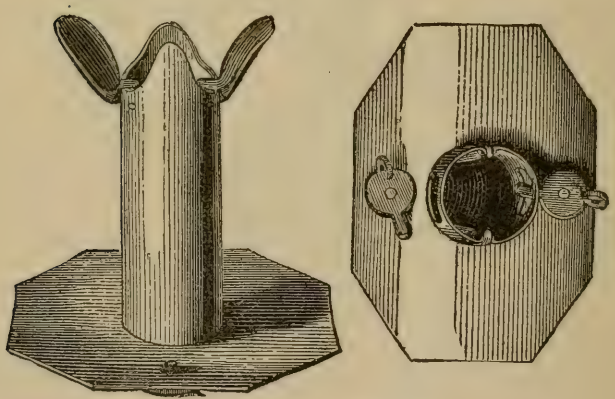


FIG. 427.—Tube of Brogniez.

the first being the the exposure of the trachea; of the second, to open it by removing a circular portion of the organ; and the third by the introduction of the tube into the aperture prepared for it.

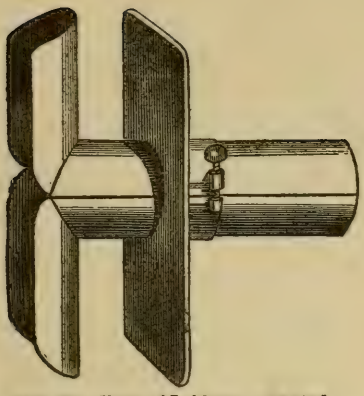


FIG. 428.—Tube of Leblanc, mounted

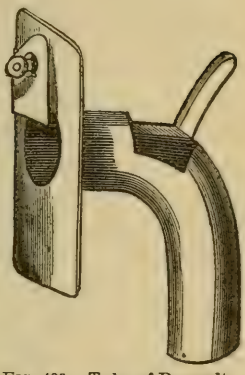


FIG. 429.—Tube of Renault.

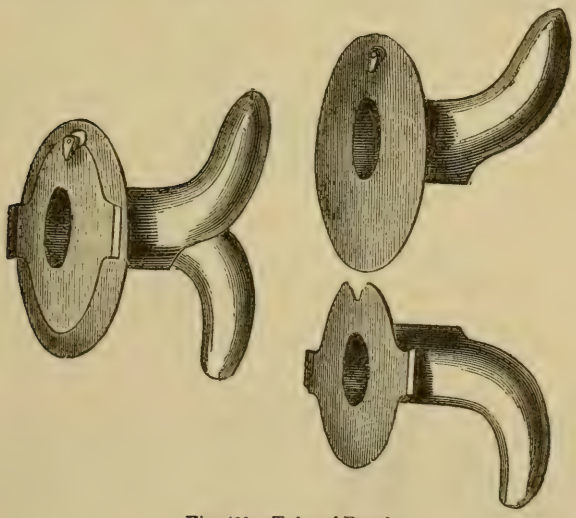


Fig. 430.—Tube of Peuch.

The operator stands facing the animal, slightly on the right. Grasping the trachea (the hair having been closely clipped), he fixes and stretches the skin with the left thumb and fore finger, at about the middle of the tracheal region, and incises it with a single stroke of the convex bistoury, cutting through the skin and the cutaneous muscle. The incision is about three inches in length, and exposes the sterno-hyoideus and thyroideus muscles. These must be carefully isolated from the face of the trachea by

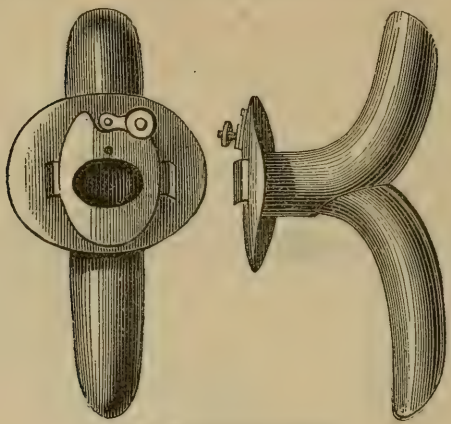


FIG. 431.—Tube of Imlin.

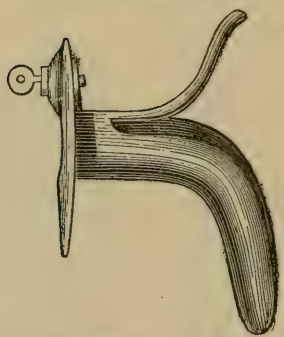


FIG. 432.—Tube of Trasbot.

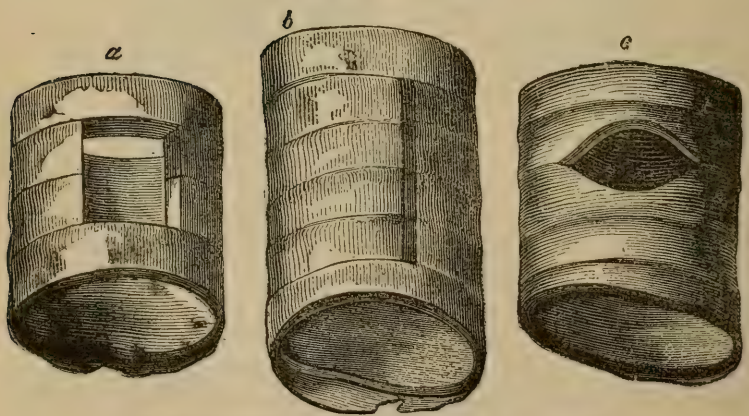


FIG. 433.—Trachea, open for the introduction of the Tube.

the dissection of the cellular tissue which confines them, and drawn apart by means of two blunt tenaculums, leaving a gaping wound through which to reach the trachea, which is thus exposed, and in readiness for the second step of the process.

Second Step.—In the second step portions of the two cartilages which have been selected, are held by the pointed tenaculum, passed through the connecting ligament, are excised, and a circular opening established by the removal of a semilunar segment from each ring. It is necessary at this point to be certain that the isolated valve is securely held, to guard against the force of suction, by which it may be liable to be drawn into the trachea as the new breathing place is suddenly opened.

Third Step.—This consists in the insertion of the tube into the aperture prepared for it, and is the simplest and easiest part of the procedure. The only difficulty likely to occur is from the neglect or error of the operator in measuring the dimensions of the opening, and securing a perfect coaptation between that and the tube. If the opening proves to be too narrow, it must, of course, be enlarged, with the caution before mentioned against losing any detached portions by the suction of the trachea. The bull-dog forceps is of value here. If the tube is of the self-holding kind, its introduction completes the operation; but if the ordinary tube before described is used, the tying over the neck of the tapes attached to the flat plate becomes the final manipulation. If no tube is at hand, the wound must be held apart with tapes applied upon its edges, and tied over the neck.

Immediate Operation by Longitudinal Incision.—This is done with the sharp straight bistoury, passing it at once through all the tissues, penetrating the trachea between two cartilages, and making a vertical incision of two or three rings. This mode, as we have said, is principally justifiable in case of emergency when suffocation is imminent, and no time can be lost in procuring the instruments necessary for the classical operation.

There is still another mode of operating, credited to Krishaber, which, from the location where it is performed, is better known as *sub-cricoidean tracheotomy*, and which consists in making the opening through the crico-tracheal ligament, which unites the cricoid cartilage to the first tracheal ring. It includes three steps, comprising the incision of the skin and dissection of the underlying muscles, the incision of the ligament, and the inser

tion of the tube. This mode of operating is simple and of easy performance, especially in the absence of any swelling of the region. It prevents perichondritis, and is not followed by changes in the diameter of the trachea. It has, besides, the advantage of allowing the tube to be, to a great extent, concealed, and thus removes one of the principal objections urged against the operation in cases of chronic roaring, for which it might well be recommended.

The subsequent measures vary somewhat, depending upon whether the operation has been performed as only a temporary expedient, or as a permanent means of relief for the difficulty in breathing. In the first case, it is not necessary to remove the tube before the acute symptoms, which have required its introduction, have subsided, which is a condition which generally does not continue more than two or three days. If, however, during that time the canula of the tube should become closed by the discharge or other pathological secretions, it must be removed, cleansed and replaced, to be left until its use becomes unnecessary, which will be readily discovered by the restored regularity of the respiration when the tube is removed or its canula becomes occluded.

If the tube is to be worn permanently, careful attention should be paid to its proper fit and adjustment, and its daily removal and thorough cleansing should never be overlooked. It should be ascertained that the instrument fits properly, being held with sufficient firmness in the opening, and making a safe and moderate pressure on the soft tissues around. When the instrument has been worn for a (variable) time, the opening of the trachea has a tendency to contract, and becomes smaller by reason of the development of the granulation of the edges of the wound. In this case it may become necessary to enlarge the opening, by the excision of the granulations, sufficiently to allow of the ready reintroduction of the tube. When it becomes desirable to close the wound, the removal of the tube, and the application of an ordinary dressing, protecting it only by a pad of antiseptic oakum, kept in place by a few turns of bandage around the neck, is all that is necessary. Usually, after two or three weeks the cicatrix is complete.

The operation of tracheotomy may be accompanied or followed by various accidents:

Hemorrhage is rare, the small amount of bleeding which occurs proceeding from the division of some of the arterioles, branches of the carotid, passing between the cartilages over the surface of the inter-cartilaginous ligament. It ceases spontaneously, and never requires any special attention.

Emphysema of the neck may take place when the cellular tissue is very loose and the edges of the skin overlap the tracheal incision. It generally subsides without interference, or by moderate, regulated pressure.

Tracheocele.—Renault so denominates certain growths which appear on the tracheal mucous membrane, as the result of the irritation produced by the friction of the branches of the tube which come in contact with it. He claims to have noticed their appearance six weeks after the removal of the instrument. The nature of the tumor varies much. They may be purulent, but they are more commonly fibrous and of slow growth; and may sometimes take the character of ossification of the cartilages. If these obstructions appear above the seat of the operation, the trouble is easily remedied by the reintroduction of the tube, but if, however, they are found below that point, it is a more serious complication, since it requires a second operation at a point below that of the first.

The *obstruction* of the trachea by plastic exudation above and below the seat of the operation, or its *contraction*, caused by the overlapping of the divided ends of the rings which may have been incised, may also be met with, and can only, as in the former case, be overcome by a second operation. We personally remember a case in which the formation of a post-tracheal abscess, which had produced extensive contraction in the calibre of the trachea, proved fatal through the impossibility of the introduction of a tube after a second operation. The patient had been treated several weeks previously for an attack of strangles, which had required an operation, and some six weeks after his recovery was brought back suffering with a severe attack of roaring. As he entered our hospital he fell to the ground, and the second operation was rapidly performed by a longitudinal incision, but the tubes we had at hand were all too large, and in a few moments the animal died. At the post-mortem a large abscess was found behind the trachea, just opposite the seat of the first operation, and the pus in collecting had so compressed and deformed the

trachea that the index finger could scarcely be inserted into the passage.

THORACENTESIS.

The usual intention of this operation is the removal from the thoracic cavity of suppurative matter (*empyema*) or blood or serous fluid, by puncturing the walls of the chest. It is indicated in hydrothorax and in some traumatisms of the chest, and whenever there is a large collection of bloody or other fluid in the thorax; in all cases, in fact, where the ordinary forms of treatment have failed to relieve the patient thus affected. Although extensively performed in human surgery, where the advantages and facilities of operating are so many and so manifest, it has naturally proved less beneficial to veterinary patients. And still, though probably in the majority of the cases in which it has been employed the relief which has followed it has been of only a temporary character, and served only to prolong briefly the life of the animal subjected to it, some few cases are on record in which it has given very excellent results. The researches of St. Cyr have, moreover, demonstrated that the operation is perfectly harmless, contrary to the opinion formerly held, and that a large proportion of its failures to effect recovery are due to the fact that its application had been too long postponed to justify a reasonable expectation of success; when, in fact, it had been deferred until the accumulation of fluid had already become too abundant, and the pleural membranes had already assumed the condition of a tendency to pyogeny.

On this point, Peuch and Toussaint remark that if the puncture is made when only the lower third of the cavity is full, and if after the evacuation of the liquid a diluted solution of tincture of iodine is injected into the pleural sac, as is done in human surgery, perhaps more satisfactory results might be realized. Our own view, however, is that the disposition of the pleura and of the cavities, which they form, would scarcely justify the injection.

The instruments required are a straight or convex bistoury, and a small trocar, straight or slightly curved. Reul has invented a *paracento-injector* trocar (Fig. 434), which is used for both the puncture and the subsequent injection of the medical compounds. The use of the aspirator (Dieulafoy) is also recommended.

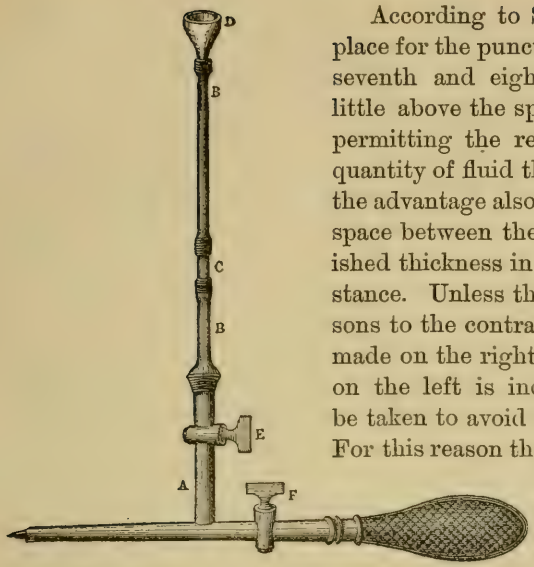


FIG. 434.—Trocar paracento-injecteur de Reul.

According to St. Cyr, the proper place for the puncture is between the seventh and eighth sternal ribs, a little above the spur vein, this point permitting the removal of a larger quantity of fluid than any other, with the advantage also of offering a wider space between the ribs, and a diminished thickness in the muscular substance. Unless there are special reasons to the contrary, the puncture is made on the right side; if operating on the left is indicated, care must be taken to avoid injuring the heart. For this reason the puncture is made between the eighth and ninth ribs, with the point of the instrument turned backward. The puncture is made with the patient on his feet, and he rarely needs any apparatus of restraint, though it will always be judicious to apply a twitch on his lip.

St. Cyr describes the operation as follows: "The operator makes an incision with the bistoury, about one inch long, near the *anterior* border of the eighth rib or of the ninth, if he is on the left side, dividing the skin and superficial muscular layers until he reaches the internal intercostal muscle, which he leaves intact. In piercing the cavity, he holds the trocar with the right hand, guarding against its entering the chest too deeply by keeping his fingers sufficiently near the point to gauge and control its depth through the remaining undivided muscle. What remains then is to withdraw the rod from the trocar, and keep the latter in place while the fluid escapes. Any albumino-fibroid clots, which may enter the canula and obstruct the flow of the liquid, may be dislodged by introducing a blunt stylet into the tube. When the canula is withdrawn after the escape of a sufficient amount of fluid, the wound is closed with a single pin suture.

The trocar of Mr. Reul is inserted (Figure 434) in the usual manner, with the nut E closed, and after removing the desired

quantity of fluid, the nut F is closed and E is opened. In the funnel D, the diluted tincture of iodine is poured and carried into the chest as slowly as the operator thinks proper, where it mixes with the remaining portion of the fluid. When the injection returns in the instrument to a level with the little piece of glass C, the nut E is closed, and the instrument removed, thus guarding entirely against the introduction of air into the chest.

In respect to the quantity of fluid that can be safely removed at once, there are varying opinions. Some practitioners hold that the cavity ought to be entirely emptied, or, at least, so far as the location of the puncture allows, while others favor the method of discharging the contents by installments.

According to St. Cyr, who has experimented very extensively in this matter, the removal of a small quantity is followed by a negative result, the fluid forming again in a very short time; while, on the other hand, if the entire accumulation is taken away at one time, amounting, perhaps, to forty or fifty quarts, it must be at the hazard of encountering, as supervening disorders, syncope, rupture of the pulmonary vesicles, congestions, or splenic or hepatic hemorrhages, with an ultimate fatal termination.

The question thus remains unsolved, and if recoveries have been recorded by Lafosse, Jr., Strauss, Massot, Bar and others, failures have followed the operation in the hands of Gohier, Pilger, Bassi, Dieterichs, Prudhomme, St. Cyr, etc. Pellé and Sewell have obtained recoveries when removing all the fluid at once. Our own experience has been negative in the cases in which we have observed both conditions—that of partial, and, as well, that of the entire removal of the fluid.

Supplementing the operation with medicinal injections of some sort has been recommended. Hertwig has used astringent solutions; Leblanc, Bouley and Prudhomme have favored the use of tincture of iodine, and the following prescriptions, used in human surgery, are recommended by Peuch and Toussaint:

Weak Solution—℞—Tinct. of iodine, 10 parts; iodide of potass., 1 part; distilled water, 100 parts.

This is first used, but, if it fails, the following is injected:

Strong Solution—℞—Tinct. of iodine, 30 parts; iodide of potass., 4 parts; distilled water, 100 parts.

The general treatment recommended for those forms of diseases in which these liquid accumulations originate, must be per-

severed in after the thoracentesis, including the counter-irritations, diuretics, tonics, stimulants, alteratives, etc.

The operation is performed on the dog also in the same manner as on the horse, but either with smaller trocars, or, what is better, with some one of the aspirators recently invented.

With this animal the results are more satisfactory on account of the simplicity and unilateral development of the pleuritic effusion.

CHAPTER X.

OPERATIONS ON THE CIRCULATORY SYSTEM.

BLEEDING—VENESECTION.

The term bleeding, or venesection, signifies the opening of certain veins for the escape of a portion of the blood, for a therapeutical, or experimental purpose. If it is designed to reduce the volume of the circulation, it is known as *general*, and is performed upon some one of the larger blood vessels; if practiced to remove blood only from a given region, it becomes *local*, and in that case the smaller vessels are divided. A better division is that which is based on the nature of the vessel which is opened, and thus it is *phlebotomy*, if a vein is opened; *arteriotomy*, if an artery; and *capillary*, or *arterio-phlebotomy*, when the operation is practiced upon the capillary system.

There has been much discussion upon the question of the utility of blood-letting, and strong advocates and earnest opponents, who have argued its benefits and denied its usefulness, and, in fact, ascribed evil results to its practice, whether the depletion affects the general circulation or a limited region. But upon this we shall not enter. Those who maintain its practice consider it to be indicated when it is desirable to reduce the activity of the circulation, or, on the contrary, to stimulate it in parts where, from different causes, it has been temporarily suspended, and to stimulate absorption, or to relieve the organism of foreign elements.

It is, however, contra-indicated in all eruptive fevers, in anæmic patients, and in those suffering with typhoid diseases.

The old fashion of "taking blood" as a prophylactic measure, or at a certain season of the year, is simply the result of an ignorant delusion.

The quantity of blood that can be removed must vary, of course, with the size, the nature and the condition of the animal.

Gourdon recommends the following scale as representing the average bleeding, proper, for the animals named :

The horse, between 4 and 5 pounds; large ruminants, 5 to 6 pounds; pig, 1 to $1\frac{1}{2}$ pounds; sheep, 6 to 9 ounces; dog, 3 to 6 ounces.

PHLEBOTOMY.

Phlebotomy, or the opening of veins, is the mode universally adopted for general bleeding, and is generally performed upon superficial veins.

The instruments necessary are fleams, lancets, scissors, bleeding-sticks, pins, pin-holders, graduated jars or vases, and a piece of silk, and, for small animals, bandages.

The fleam, made in various forms, resembles a small lancet, and is secured on a steel support received into a metallic, horn or gutta-percha handle. Ordinarily, two or three lancets of different

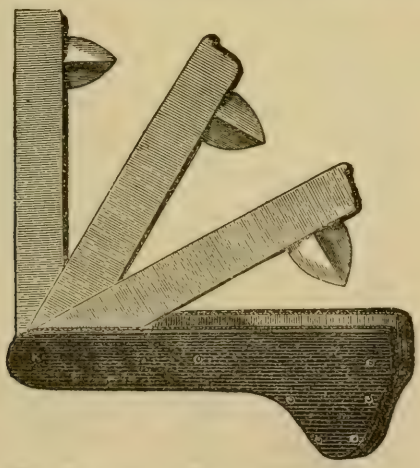


FIG. 435.—Ordinary Fleam, with three blades.

sizes have one common handle, upon which they are so mounted as to be used singly with facility.

Some of them, of German make, or of English invention, or of a Belgian pattern, act with a spring, like the phlebotome of Brogniez.

The *bleeding-stick* is simply a stick of hard and heavy wood, a foot or more in length, with which to drive the fleam into the vein.

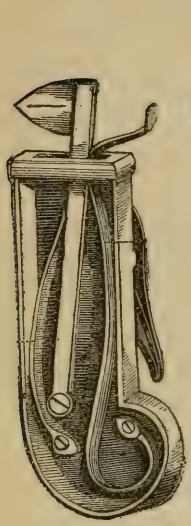


FIG. 436.

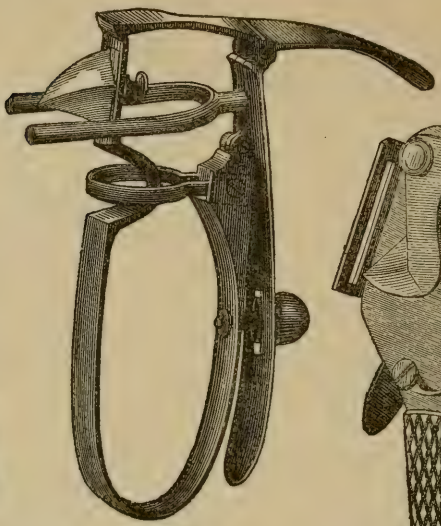


FIG. 437.

FIG. 438.

FIGS. 436, 437, 438.—German and English Spring Fleams.

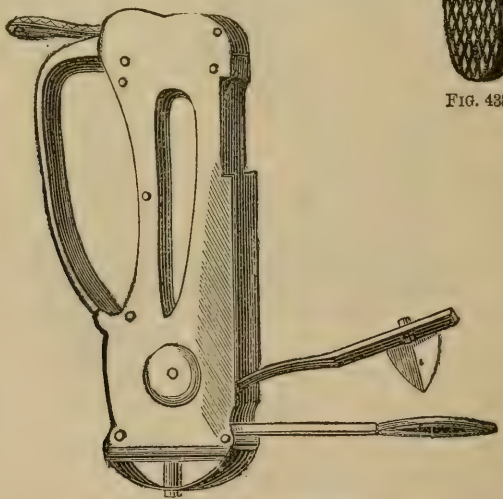


FIG. 439.—Fleam of Brogniez.

FIG. 440.—Bleeding Stick.

The *graduated vase* is to receive the blood, and at the same time measure its flow. In ordinary practice a pail is substituted.

The *pins* must be long and strong. The *pin-holder* is used to assist in the introduction of the pin when the suture is made and the bleeding terminated.

Sponges and cold water should be accessible.

Modus Operandi.

Position of the Animal.—The standing position is the one generally preserved. The animal is held well in hand by an assistant, and if he appears to be excited and unwilling to stand quietly, and soothing treatment has no effect, a twitch is placed on his nose, or a cap on his head.

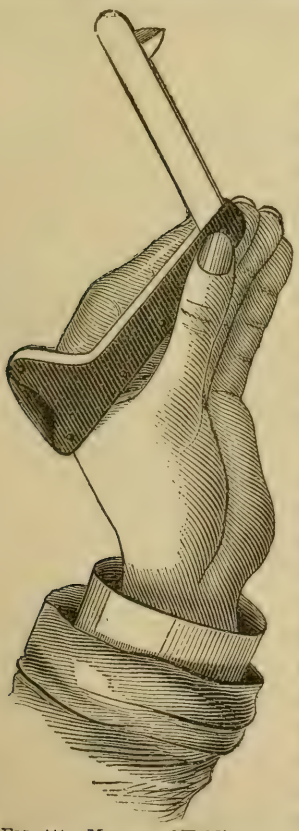


Fig. 441.—Manner of Holding the Fleam.

The operation consists of three steps:

1st. *Preparation of the Blood Vessel:* This consists in applying sufficient pressure upon it to temporarily interrupt the circulation and cause it to become more prominent under the skin. This is done with the fingers, and sometimes with a ligature, when the location of the vessel permits it. In some blooded and thin-skinned animals, a little brisk exercise is sufficient to stimulate the circulation and render the veins prominent.

2d. *Opening of the Vessel.*—This is done with the fleam, the lancet or the bistoury. The fleam is more commonly used for large animals. Held as in figure 441, it is brought opposite the vessel, parallel to its course, and perfectly perpendicular to it, and at such a distance from the skin as to approximate very nearly, but without forming an actual contact with it. When in this position the fleam is made to penetrate the vessel by a smart blow with the bleeding-stick on the back of the blade; some practitioners, instead of

striking with the stick, apply the blow with their hands, but with cattle, the stick is indispensable. The moment the blow has been applied properly, the stream of blood escapes freely; when the blow has been too light, and the skin only divided, with but a scanty or no escape of the blood, it is called a *white bleeding;* and *slabbery* when the opening is not large enough for the escape of a full stream, or when the openings of the vein and of the skin are not in apposition, which will be the case if the fleam, instead of being held perfectly perpendicular to the skin, has been held obliquely. The opening of the blood vessel with the spring fleam is performed in the same manner, except that the lancet receives its impulse from the spring instead of the stick. The puncture with the lancet or bistoury should be made with a single stroke of the instrument. In large and superficial veins, the spring lancet is as easily and safely managed as the fleam.

3d. *Closing the Blood Vessels and Stopping the Flow.*— When a sufficient quantity of blood has been drawn, and the pressure upon the vein, which has been continued during the flow, is gradually relaxed, the stream ceases, more or less completely. To terminate it entirely, a simple stitch of pin suture is applied. It is to be preferred to all other means, such as pressure, bandaging or adhesive plasters. The suture is made by grasping the two edges of the skin with the thumb and index finger of one hand, and slightly raising them, then transfixing them with a long pin through their middle, with either the hand or the pin-holder, including a fair amount of skin, and completing it by a special knot, made with silk or a loop of the long hair of the mane or tail of the animal. In applying this suture, the skin must not be pulled away from the body too far, nor the knot tied excessively tight. To keep the wound clean and prevent the animal from rubbing off the dressings is all that is necessary, for a few hours, after the operation. The wound heals by first intention, and the suture and the pin can be safely removed after twenty-four hours.

FIG. 442.—Suture after Bleeding.

PHLEBOTOMY IN SOLIPEDS.

Four of the principal superficial veins are selected for this operation in solipeds; the jugular, the cephalic, the subcutaneous thoracic and the internal saphena.

Phlebotomy at the Jugular.

This vein is usually selected on account of its size, its situation, and the facility with which it can be opened, and the wound of the skin closed. It is, however, contra-indicated when the vessel is in any degree diseased, or when the animal is suffering with itching skin diseases.

Formed by the superficial temporal trunk and the internal maxillary vein, the jugular descends through the parotid gland toward its inferior extremity, receiving several collateral veins, and reaches the groove of the lower part of the neck, which from its presence is called the *jugular groove*, until it reaches the lower extremity of the neck, when it enters the chest. In its course in the groove it accompanies more or less closely the carotid artery,

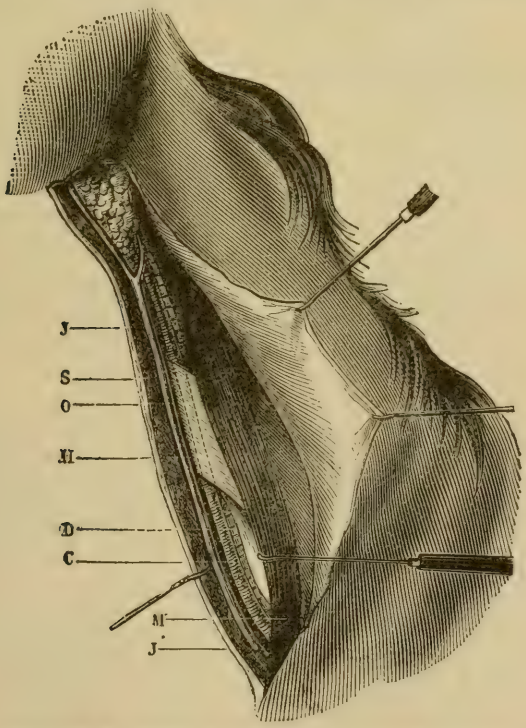


Fig. 443.—Anatomy of the Jugular Vein and Œsophagus in the Horse. J J, jugular vein; C, carotid artery; O H, omo-hyoideus muscle; D, œsophagus; S, sterno-maxillaris muscle; M, mastoido-humeralis muscle.

but in the middle third of its length becomes separated from it by the flat ribbon-like structure of the sub-scapulo or omo-hyoideus, whose fibres pass obliquely between the two blood vessels, from below upward. It is, therefore, in the middle third of the neck that the bleeding at the jugular must be made, in order to avoid wounding the carotid artery.

Besides the general rules already stated, this special bleeding requires peculiar measures.

(*a*) *Position of the Animal.*—He must be kept well in hand, with the head somewhat elevated, and must be prevented from seeing the various movements of the operator, by covering his head with the cap or mask, or by having the eye, on the side of the operator, covered with the hand of an assistant.

(*b*) The fleam is generally employed, the size of the blade varying according to the thickness of the skin and the condition of the blood vessels. The left jugular is generally selected, unless contra-indicated for some special reasons.

(*c*) *Preparation of the Vein.*—The application of artificial pressure for the dilatation of the vein is not only unnecessary in solipeds, but has in some cases proved dangerous. In this step of the operation the hand is to be preferred as safer and more reliable than any ligature or bandage can possibly be.

The compression is made with the fingers of the hand which holds the fleam, applying it in the jugular groove, below the point where the incision is to be made. The projection of the vein may be made more distinct by moistening the hair over the spot to be punctured, with a wet sponge. The improper habit to which some practitioners are addicted, of doing this with their saliva, by spitting upon the neck is to be severely condemned. If the bleeding takes place on the left side, the pressure must be made with the left hand, the operator turning his back toward the hind parts of the animal. If it takes place on the right side, the pressure is made with the fingers of the right hand.

(*d*) *Opening of the Vein.*—Placed as we have described, at the side of the neck of the patient, his back turned toward his hind parts, and pressing with the fingers of his left hand which holds the fleam, as before stated, the operator grasps the bleeding-stick, and striking upon the fleam, opens the vein, and the blood escapes in a good, full stream. Maintaining the pressure on the vein throughout the flowing of the blood, he lays aside the stick

and the fleam, and attends to the flow of the blood into the graduated jar, or the pail provided to receive it.

(*e*) *Keeping the Stream.*—As we have said, the pressure upon the blood vessel must be sustained from the beginning to the end of the operation. Relieving it but for a moment is an error, likely to be followed by the introduction of air through the wound into the vein. Not only must it be kept up continuously, but it must be steady. The habit which largely prevails of moving the fingers or the vase up and down along the vein while the pressure is applied, and with the idea of stimulating the flow of the blood, is most dangerous. If the blood does not escape freely, though the operation has been properly performed, an increased circulation may be stimulated by making the animal move his jaws, or shaking the bit in his mouth, or placing the bleeding-stick or a finger of the assistant, into the mouth over the bars, and quietly moving them.

(*f*) When the bleeding is to be stopped, the operator applies one of his fingers over the wound of the skin and gradually removes the pressure made below it. When this has been done, he proceeds to the application of the suture, always introducing the pin with the head turned upward, irrespective of the side on which the operation has been performed.

(*g*) *Subsequent Care.*—This is the same as in other cases, but we may add that an animal that has been bled at the jugular is unfit to work for three days, in order to give time for the wound to heal completely.

Phlebotomy at the Cephalic Vein

The cephalic is one of the terminal branches of the median subcutaneous vein, and runs upward and forward to pass toward the lower extremity of the coraco-radialis, where it crosses the tendinous band which this muscle sends to the anterior extensor of the metacarpus, running in the space which separates the sterno-humeralis muscle from the levator-humeri, and emptying into the jugular, a little in front of the confluent of those two veins. In this course, the most accessible portion is that which rests on the inferior extremity of the levator-humeri. The fibrous band of the coraco-radialis is the guide indicating its position, viz., a little inside the forearm, on a level with the anterior and oblique fold which separates the arm from the forearm.

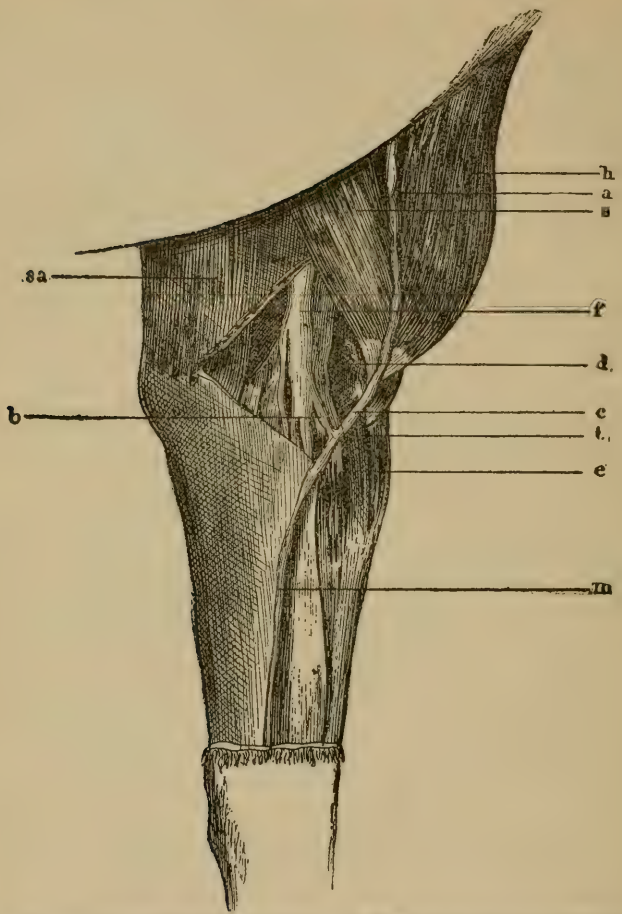


FIG. 444.—Anatomy of the Cephalic Vein. *m*, Median subcutaneous vein; *b*, basilic vein; *c*, cephalic vein; *d*, inferior extremity of the coraco-radialis; *t*, aponeurotic band extending from the coraco-radialis to the anterior extensor of the metacarpus; *s*, sterno-humeralis; *h*, mastoido-humeralis; *a*, space between these two muscles; *f*, humeral vein.

On account of the presence of the other terminal branches of the main vein, from which the cephalic rises, viz., the basilic, pressure upon the cephalic does not allow of its dilatation. To obtain this, the animal must be exercised for some time, and when brought to stand still, to raise the opposite leg, or to carry the leg to be bled forward.

As the vein is easily displaced from its position, it is hardly

safe to attempt to open it with the lancet. The fleam is always preferable. If the bleeding is from the left vein, the instrument is held with the right hand, the operator is placed against the shoulder, fleam having its blade turned downward, the fingers resting against the chest, and with a blow of the stick the vein is opened. This bleeding is often accompanied by the formation of a hematoma over the course of the vessel, due to the fact that very often the fleam has opened the vein through and through. This, however, is not a matter of any serious consequence.

Phlebotomy on the Subcutaneous Thoracic.

This vein runs on the side of the thorax, on a level with the sterno-trochineus muscle, and is readily discovered toward the sixth or seventh rib. To render it more conspicuous, a bandage can be applied around the chest, as suggested by Chabert, or by carrying the leg of the side to be bled forward, and by rubbing hard the tract of the vein, or even by simple pressure with the fingers.

The operation can be performed either by a simple puncture with a lancet, or with a fleam, held parallel with the course of the vessel, and between two ribs, to avoid breaking the instrument against one of the bones. The bleeding is stopped in the usual way. It is not unfrequently followed by the formation of a thrombus, which generally disappears by pressure, or astringent local applications, and often by spontaneous absorption.

Phlebotomy at the Internal Saphena.

The comparatively large size of this vein, and its superficial position, both explain and justify the fact that next to the jugular, it is the one most commonly selected for the operation. For this reason phlebotomy is indicated here, when it is contra-indicated upon the vein of the neck.

The saphena is formed by two branches, and in its course crosses slightly the direction of the tibia in running upward on the surface of the tibial aponeurosis, arriving at the flat of the thigh, formed by the short adductor of the leg, and then dips in the space left between this muscle and the long adductor, where it empties into the femoral. In this course the vein is superficial, covered only by a thin skin, from which it is separated by a thin aponeurotic layer. It is at a point where the vein passes over the

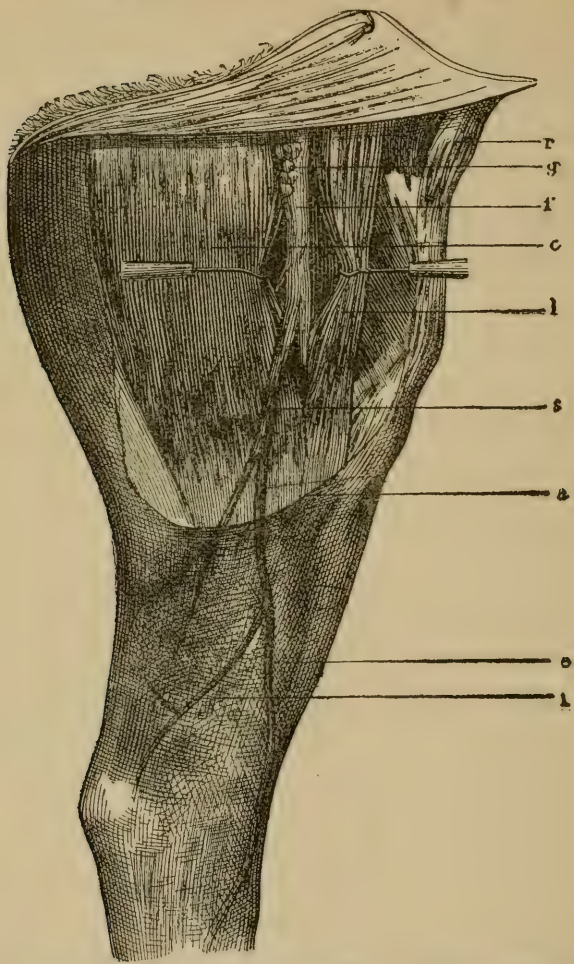


FIG. 445.—Anatomy of the Internal Saphena Vein. *s*, internal saphena vein; *e*, its anterior root; *i*, its posterior root; *f*, femoral vein; *g*, deep inguinal lymphatic glands; *c*, short adductor of the leg; *l*, long adductor of the leg; *a*, subcutaneous aponeurotic layer; *r*, fascia lata.

flat of the thigh that it must be opened. If the operation is performed with the fleam, the higher the better; if with the lancet, it can be done as the vein passes over the tibia, where it is more accessible.

In operating, the leg opposite the one to be bled is held up and backward by a strong assistant, in the posture of the blacksmith about putting on a shoe.

If the lancet is used, the operator, placing himself on that side also, bends down, and, looking from under the abdomen of the horse, brings the instrument close to the vein, opening it by a rapid stroke, and enlarging the orifice by a slight incising motion of the instrument.

If the fleam is used, the operator assumes the same position, and applies it precisely as has been described in the cases already considered.

Operating on the right side he holds the fleam with the right hand and strikes with the bleeding-stick in the left, and *vice versa.*

This position of the operator is awkward, and not without danger, exposing him to the chances of a blow with the stifle of the leg which is held by the assistant. To avoid this, Peuch and Toussaint suggest that the assistant, instead of holding the leg backward, should carry it forward, and that the operator should place himself behind the animal. It is also claimed that in that position the vein is more easily exposed. The operation is performed in the same way, except that the instrument is held with the right hand if one operates on the left leg, and with the left hand if the bleeding is done on the right leg.

The flow of the blood in this bleeding is generally slabbery, and the introduction of the pin of the suture quite painful, and means of restraint are, therefore, often necessary before the animal will submit to the application of the suture.

Phlebotomy on Other Superficial Veins.

Others, besides the veins which have been described, are also subject to phlebotomy, but its performance is more with some local object in view than that of a general bleeding.

All are performed with the lancet, the region (Fig. 446) where they occur being at the *transversal* of the face, a; the *angular of the eye* (b); the *facial* or *glosso-facial*, d; the *superficial nasal*, (c); the *posterior auricular* (e); the *deep lingual;* the *inferior caudal*, and the *median subcutaneous* of the *forearm.* If required by their size and position a pinned suture is applied after the bleeding, but in several instances pressure alone is sufficient.

Phlebotomy in Large Ruminants.

The operation is confined to two principal veins of the large ruminants. These are the *jugular* and *subcutaneous abdominal.*

FIG. 446.

PHLEBOTOMY ON THE JUGULAR.

It is performed in the same manner essentially as in the solipeds, and with the same instruments. But as cattle are less submissive to the preparations which precede the operation, means of restraint must be used with them, and they must be tied to a tree or a post. The jugular of cattle has thicker walls than that of solipeds, its diameter is much greater, and it is separated from the carotid in its whole length by a thicker layer of muscle. For these reasons a larger fleam becomes necessary. To dilate the vein a strong ligature is applied tightly on the neck, the pressure of the fingers never being sufficient to furnish the necessary force. To open the vein the blow of the stick must be heavier, and when properly given is followed, as in solipeds, by a strong stream of blood, which rapidly ceases when the ligature is loosened or removed. It is not always necessary to apply a pinned suture, but it is always safer and more prudent to do so, though the introduction of the pin is rendered difficult by the toughness and thickness of the skin. The value of the pin-holder is demonstrated in this case.

The thrombus which so often follows this operation is not serious, and, in fact, its formation is stimulated by some practitioners.

PHLEBOTOMY AT THE SUBCUTANEOUS ABDOMINAL.

This vein is of enormous volume, extending from the udder to the xyphoid cartilage of the sternum, at the side of the abdomen,

to terminate in the internal thoracic vein. It is, therefore, easily recognized, and particularly so in milch cows, and it is, therefore, unnecessary to use the ligature or any other means to swell its dimensions, the pressure of the fingers being more than sufficient. A fleam of medium dimension is preferable to the lancet in this case. The animal is firmly held by the head, and to prevent his kicking, is pulled forward by its tail passed between its hind legs. In opening the vein the operator places himself forward of the shoulder, his back turned toward the head of the animal, holding the fleam with the hand corresponding to the side of the animal against which he is placed. The bleeding is stopped with a pin, or, what is better, a bandage, to prevent the formation of a thrombus.

Phlebotomy on Small Animals.

Bleeding is seldom performed on sheep. When it is indicated it is performed on the *facial*, the *jugular*, the *cephalic*, or the *external saphena*. The vessel is opened with the lancet, the wool,

Fig. 447.—Position of the Facial Vein in Sheep.

if necessary, having been clipped off from the place of puncture, and the wound is closed with a pin suture.

In *swine* two sets of veins are eligible for the operation, the *posterior auricular*, as it runs at the internal face of the ears, and the *external saphena*, where it passes along the tendo Achilles. The lancet is used upon both. The first stops bleeding without help; the second is closed with the pin suture.

In *dogs*, the *jugular* is sometimes opened. This vein, from its position, requires the application of a string around the neck to swell the vessel. The puncture is made with a small fleam or a lancet, and the wound closed with a pin. The *external saphena*

being quite large is chosen in preference to the *internal*, which is very small. The place of selection is the superior part of the vein, when it nearly reaches the posterior border of the leg. A bandage is applied to stop the hemorrhage. The *cephalic* might be opened as it passes toward the interior third of the humerus, the wound being closed by a stitch of twisted suture.

ACCIDENTS OF BLOOD-LETTING.

The operation of blood-letting may be followed by several complications, some being of little importance, while others may be sufficiently serious to compromise the life of the patient. Among them may be named: The white and the slabbery bleeding; wounds of surrounding non-vascular organs; the thrombus; inflammation of the vein, or phlebitis; wound of the carotid, and the introduction of air into the veins. Others, such as the lesions of nerves, syncope, etc., are seldom, if ever, encountered in veterinary practice.

1st—White and Slabbery Bleeding.

It is a question whether these, properly speaking, should be classed among the true sequelæ of blood-letting. We already alluded to them when describing the various methods of performing phlebotomy. They are often the result of the disposition of the parts, the vein being deficient in size, or more deeply situated than natural, and thus imbedded in the loose surrounding cellular tissue; or, perhaps, the cause is an unguarded movement of the animal; and it is often known to be the imperfect manipulation of the surgeon in striking the fleam too lightly, or not vertically, and so failing to bring the openings of the skin and the vein into exact coaptation.

These accidents are, however, of an unimportant character, and are easily obviated by exercising more care and deliberation.

2d—Wounds of Surrounding Non-vascular Organs.

(*a*) *Wounds of the Trachea.*—The improper action of the surgeon is generally chargeable with this accident. He may have erred in using too large an instrument, or the error may have consisted in making excessive pressure when ligating the neck with the cord used to effect the distension of the jugular. It is a rare

accident, but may be easily recognized by the flow of blood which escapes through the nostrils, and possibly by the changes which may affect the respiration by threatenings of strangling, suffocation, etc. In this serious case the ligation of the blood vessel is the only means of stopping the hemorrhage.

(*b*) *Wounds of the Caudal Muscles.*—This is comparatively a common accident with cattle, but is seldom attended with symptoms of a serious character. The principal danger consists in the possibility of the formation of fistulous tracts, more or less rebellious to treatment, as besides the muscles, the tendons, and even the bones may have been injured by the instrument.

3d—Thrombus.

This is understood to be a bloody tumor, or hematoma, which is formed around the opening of the vein by the accumulation of the blood in the surrounding cellular tissue. It appears when the opening of the vein does not accurately correspond with that of the skin, or when the incision of the tegument is too small to allow a free flow of the blood through it. It often appears when the animal is allowed to rub himself after the operation, or when the opening of the vein has involved a section of one of the valves. Some veins, as the saphena, the cubital, and the subcutaneous thoracic, are more exposed to thrombus than others, even when the operation has been well performed and completed. At these veins, they are generally not serious, and are readily subdued by simple treatment, if they do not spontaneously disappear.

But the thrombus, which is sometimes encountered at the jugular, is of a more serious character, and is not unfrequently complicated with phlebitis.

The symptoms of this lesion are essentially local, and the symptoms and the disease are, in effect, one, consisting of a tumor of uncertain dimensions, according to the quantity of blood collected under the skin. In the beginning it is round, well circumscribed, soft, and slightly elastic to the touch, but the swelling soon becomes hard, perhaps œdematous, or somewhat diffused, when it has been caused by rubbing on the part of the animal.

The simplest cases gradually disappear after two or three days. But at other times they are not so tractable, and serious trouble may ensue, the tumor becoming stationary, or perhaps increasing in size, and then changing its character. It becomes warm

and painful, assumes aspects of a phlegmonous nature, and perhaps becomes complicated with hemorrhages. It is not yet too late to look for resolution, but if it does not soon take place, and if the symptoms increase, and the swelling extends, the vein is changed into a hard, large cord, and a case of phlebitis is established.

Absorption and *resolution* are now the two most favorable terminations of thrombus, but they are of unusual occurrence, except when the tumor is of small size, and promptly attended to.

Suppuration is the more common event, and if this continues to be superficial, recovery may be looked for without obliteration of the vein.

Phlebitis, which commonly accompanies a deep suppurative thrombus, is always a serious termination. Abscess of the thrombus, however, may assume various modifications, and may pass to a chronic condition, or that of *induration*, or one of still more serious nature, that of *gangrene*.

When it has become developed, the animal must be immediately secured to prevent him from rubbing the parts, and as early as possible the treatment should be directed to the limitation of its development and the promotion of its absorption. Local applications of cold water; astringent compresses, moistened with vinegar or lead solutions; poultices of clay, of soot, or of chalk, mixed with vinegar, will very often be sufficient to control or remove the growth. Sometimes, however, the absorption will be more effectually stimulated by frictions with cantharidis ointment, and in a week or ten days the thrombus will have entirely disappeared. The Girard ointment, of Venice turpentine and bichloride of mercury, is sometimes also very effective.

If the tumor assumes the nature of an abcess, and this remains superficial, it may be opened with the bistoury, or the actual cautery, and should hemorrhages occur they must be principally controlled by pressure.

4th—Phlebitis.

The first effect of the inflammation of veins is the coagulation of the blood and the formation of a clot in a given length of the vascular canal, adherent more or less to the walls of the vessel, the result being the partial or perhaps complete obliteration of the vein, and hence a certain disarrangement of the circulation, which

may be supplemented by the anastomotic action of collateral vessels above and below the occluded portion. Or, again, the circulation may be entirely obstructed, and, as a consequence of the inflammatory changes, adhesions follow, between the clot and the venous wall, the clot being resorbed, and the obliterated vein transformed into a fibrous cord. So long as the inflammation is limited to the internal wall of the vessel, phlebitis is known as *adhesive*; but if it extends to the external or even to the middle structure, and becomes *suppurative*, it is so distinguished. Either of these forms of the disease may be changed by a third modification to that of *hemorrhagic phlebitis*. These three forms or diversities of the disease have been established by Peuch and Toussaint, whose views touching the treatment of the affection we also reproduce, referring our readers for the pathological history of the lesion to the various works relating to it.

1st. *Adhesive Phlebitis.*—At the beginning of the disease, the animal must be placed under such conditions as will tend most favorably to influence the process of organization between the clot and the venous walls, and to prevent the establishment of suppuration. To effect this object, the enforcement of a state of immobility in the patient is most essential. His head must be firmly secured on both sides, and his mastication made as easy as possible, by suitably regulating the consistency of his diet, in order to diminish the force of the circulation, and so far obviate the danger of the displacement of the clot and possible resulting hemorrhage. The diseased parts should be treated by local applications, among which lotions of lead water, with continued cold water irrigations, will give excellent results. But ointments of any kind should be avoided, especially in warm weather, from their liability to become rancid and irritant, and to stimulate the patient to rub himself. The use of cooling applications must be persevered in, in preference to the frictions with vesicatories, which, especially in nervous animals with tender skin, might be liable to encourage the suppurative process. In tougher-skinned animals, and those of a lymphatic temperament, in which the inflammation has a tendency to become chronic, resolvents, blistering, liquid liniments, and alteratives are indicated, and of these, and first in order, must be named cauterization with the red iron. The conical cautery is applied on closed, fine points, and arranged quintuply, every second point being deep, while the others are

only superficial. By this peculiar mode of firing the absorption becomes greatly stimulated, and the resorption of the tumor very rapid. Cauterization, however, if beneficial in chronic, is not so in acute cases, having in the latter a tendency to be followed by suppuration,

2d. *Suppurative Phlebitis.*—For this form of this serious affection several modes of treatment are proposed.

(*a*) *Expectant Treatment.*—This is the plan by which the physician or surgeon, administering palliatives only, trusts to the *vis conservatrix* for cure, watching meanwhile the development of the disease, and waiting for and *expecting* the guidance of nature in respect to his own interference.

(*b*) *Simple Incision.*—This is the simplest of surgical interferences, and means nothing more than the opening of the abscess, the enlargement of the fistulous tract, and the formation of an exit for the pus and coagulated blood which it contains. This is done with an ordinary bistoury, guided by a probe or grooved director.

(*c*) *Injections.*—The fistulous tract which exists on the phlebitic tumor is washed with a detersive injection of solutions of tincture of iodine, or perchloride of iron; or of corrosive sublimate, from $\frac{1}{500}$ to $\frac{1}{1000}$. These are intended not only to remove any remaining clots softened by the suppuration, but also to stimulate the granulations and the cicatrization.

(*d*) *Enlargement of the Fistula and Introduction of a Seton.*—An S probe is introduced into the fistula, and when it has reached the upper part of the swelling formed by the vein, close to the obturating clot (which must not be disturbed), an incision is made over its blunt end to enable it to pass out through the skin. The fistulous tract is then enlarged with the straight bistoury from below upward to a small extent, and between the two openings a small seton is passed by means of the probe, and secured in place by knotting the ends. The movement of the seton by drawing it to and fro, effects the removal of such portions of the clot as may remain in the wound.

(*e*) *Enlargement of the Intra Venous Fistula in its Whole Length.*—This consists in opening the tract from its commencement to its superior *cul de sac*, as far as the adhesion between the clot and the vein extends, the incision sometimes reaching below the opening made by the fleam. Thus exposed, the tract

is washed out with the tincture of iodine or perchloride of iron solution, or even destroyed with the actual cautery. The last two forms of treatment, however, are dangerous, from their liability to occasion consecutive hemorrhages.

3d *Hemorrhagic Phlebitis.*—The most serious incident of phlebitis, proceeding, as it does, from both the adhesive and the suppurative forms, is the more or less abundant hemorrhage, which, resulting from any of the various causes which have been mentioned, may interfere with the cicatrization or obliteration of the venous wound. Three modes of treatment are practiced for their suppression. These are the twisted and the quilled suture, and the ligation of the vein.

(*a*) *The Twisted Suture.*—This consists in the combination of several (two or three) long pin sutures, placed upon the wound made by the fleam, and including a larger portion of the skin at the sides than the single pin suture of an ordinary bleeding. Sometimes wooden pins are substituted for those formed of metallic material, and when the sutures are completed, the wound is strengthened by a coating of some strong, adhesive mixture. Some practitioners, however, prefer to this the application of a severe blistering friction, which, by the pressure of the swelling which it produces upon the internal circumjacent parts, secures practically all the effects to be obtained by a compressive bandage.

(b) *Quilled Sutures.*—These are applied on each side of the wound, securing a good hold by placing them at some distance from the edges, and embracing tightly between them a thick portion of the skin. This point is important, for the reason that this portion of skin is destined to be sacrificed by being left to slough off, and this must not take place until the obliteration of the wound is entirely completed.

(c) *Ligature of the Vein.*—The success of this operation, to be assured, requires the selection of a healthy portion of the vein on which to place the ligature, even if it become necessary to look for it among the original roots of the jugular, viz., the facial and the glosso-facial. In performing it, the animal must be secured in the recumbent position. A single incision is made through the skin, the whole extent of the obliterated vein, parallel to its axis, and the vessel exposed and separated from the surrounding tissues. The separation, which requires skillful and cautious manipulations, can be effected by means of either a director or a long probe. It

will be no more than a wise precaution to apply a second ligature below the clot, to prevent the possibility of the escape of suppurative matter into the general circulation. The material of the ligature may be either ordinary linen cord or silk. Our own preference is for sterilized catgut. The resulting wound is treated in the manner proper for all similar wounds, and in from twenty to twenty-five days complete recovery may generally be looked for

4th. *Wound of the Carotid.*—This complication of phlebotomy at the jugular is not of common occurrence, but is easily possible. It may become one of the consequences of using a fleam unnecessarily large, and out of proportion with the dimensions of the vein and the thickness of this skin; or it may be caused by the exhibition of needless violence, in striking too heavy a blow with the bleeding-stick. Nor are these the only causes to which wounds of the carotid may be referred. An abnormal anatomical disposition of the artery, either permanent or temporary, may cause it to receive the wound designed for its neighbor the jugular.

The symptoms pertaining to this accident are very characteristic. The color and volume of the blood, and the rapidity of the per saltum flow of the stream are sufficient evidences of the arterial and non-venous source of the hemorrhage. Concurrently with this, a swelling takes place around the edges of the wound, increasing with greater or less rapidity, and nearly resembling the ordinary thrombus of venous extravasation, though differing from it by the rapidity of its formation.

This *false aneurism* is now subcutaneous, and has a tendency to extend itself downward toward the lower part of the neck, and has, indeed, been found extending as far as the entrance to the chest.

This accident is generally one of a serious nature, not alone in itself, but often because of the specific manipulations which it necessitates in order to overcome it. There are, however, several fatal cases on record. The indications of treatment may be either quite simple, or, at times, of serious import. If the puncture of the artery is but a small one, and the flow not abundant, one or two strong pin sutures may be sufficient to control it, especially if associated with it steady and firm pressure is established directly upon the course of the vessel, either by compressive bandages, or, what is better, with the fingers firmly pressing in the jugular groove. If, however, the wound is large, and accompanied by a

correspondingly profuse hemorrhage, it becomes necessary to have recourse to the direct applications of a ligature. A description of this operation will be made the subject of our chapter on hemostasia.

5th. *Introduction of Air into the Veins.*—This is one of the most remarkable of the accidents attending the operation of phlebotomy. The phenomenon has been observed as early as the seventeenth century, but it was not until 1806 that it was observed and recorded as belonging to the category of casualties connected with the familiar act of blood-letting in an animal. The first author to put the occurrence on record in this connection was Verrier, who reported a case in 1806, and he was soon followed by others with accounts of their experience with the same lesion and operation in human practice.

There are two principal causes to which this accident can be attributed. One of these may be an unnecessarily large aperture in the vein, but more commonly it follows improper manipulations on the part of the surgeon, particularly the irregular pressure made upon the vein during the flow, by many practitioners, who have formed the habit of rubbing the vessel along its length, under the erroneous idea that by this movement they accelerate the bleeding. Again, and perhaps principally, the casualty may be the result of neglecting to close the wound of the skin with the finger below the point from which the current proceeds, *before the pressure upon the vessel is stopped.*

The occurrence is made known by a peculiar gurgling sound, which is made more evident by auscultation of the heart. In the meantime, the animal is attacked by shiverings; the respiration becomes accelerated; there is a rapid heaving of the flanks; the body becomes covered with perspiration; the action of the heart is quickened; the countenance becomes anxious; the animal is seized with convulsions; falls down and dies, unless by the continuance of the flow through the open vein the air may be carried out through the same channel by which it entered, or unless the quantity has been very minute. As the result of our own study, tested by many experiments, we have become strongly inclined to believe that the quantity of air necessary to produce death must be very large, more, in fact, than a careful operator would allow to enter without attempting to prevent it.

The possibility of the occurrence of this accident may easily

be obviated, seeing that it merely requires careful attention to the execution of the few details which constitute the act of venesection. But when it has taken place, the simplest and most obvious thing to do is, if possible, to remove the air from the vessel in which it has intruded. The means of effecting this consists in reopening the closed vein, and permitting the blood to resume its flow. The loss of three or four pounds of blood additional is usually sufficient to insure the escape of all the air. Gourdon recommends, in addition, showering with cold water, stimulating frictions, and even, if the case seems to require it, artificial respiration.

ARTERIOTOMY.

Bleeding from an artery is so termed to distinguish it from phlebotomy. It is not commonly used in practice, being principally resorted to as a means of local depletion, and is performed only on some of the most superficial of the vessels. In fact, there are but three of these eligible by their position to the operation. These are the *transveral of the face,* the *posterior auricular*, and the *middle caudal.*

The *modus operandi* differs but little from that of phlebotomy, except that there is usually no need of the application of artificial means to swell their bulk or increase their rotundity, their position, and their distinct and characteristic pulsation, so readily detected, sufficiently revealing their location and course. In opening arteries the fleam is seldom used, the lancet or a pointed bistoury being a much more eligible instrument. The incision of the vessel is made across its course instead of longitudinally, as in phlebotomy, and the flow of blood must be arrested by means of pressure with compresses or bandages.

(*a*) *Bleeding at the Transversal of the Face.*—Though the position of this artery is nearly correspondent in all animals, it is principally with solipeds that it is chosen for blood-letting. It is situated below the temporo-maxillary articulation, and crossing the direction of the fibres of the masseter muscle, where it is covered only by a fine skin, it is opened at the same level with the place where phlebotomy is usually performed. Some operators prefer casting the animal, others the standing position.

The appearance of the vessel is that of a small, round pulsating cord, and, as before stated, it is incised, not as the veins and

opened, but in the direction of its axis. The stream differs from that which flows from a vein, and instead of issuing with a regular flow, escapes *per saltum*, or by alternating leaps, synchronous with the action of the heart. It also differs from that of the veins in color, being of a lighter and brighter red. As the application of a pin suture will scarcely be sufficient to perfectly suppress the flow, pressure must be resorted to, either by direct application over the posterior border of the maxillary bone, or over the place where the artery passes, or by covering the incision with a pad of oakum, retained by means of a circular bandage passing by several turns over the upper part of the head. The animal should be tied up for several days after the bleeding, or until the closing of the artery is fully assured.

(*b*) *Bleeding at the Posterior Auricular.*—Though the transversal of the face can be opened in large ruminants, as well as in horses, arteriotomy in those animals is more commonly performed upon the posterior auricular, where it is attended by all the conditions of size and position required to serve the convenience of the surgeon. In *cattle*, upon which it has been practiced for both its *general* and *local* effects, it has been recommended in diseases of the brain, and for affections of the eyes and other parts of the head. The posterior auricular runs under the parotid gland from the base of the concha upward on its external face, near its supe-

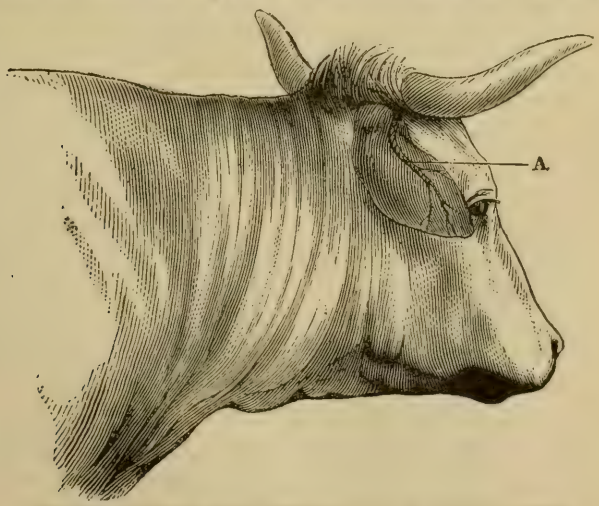


FIG. 448.—Anatomy of the Posterior Auricular Artery in Cattle.

rior border, where it loses itself. It is most superficial toward the base of the cartilage as it issues from under the posterior cervico-auricular muscle.

The operation is comparatively simple. The animal being firmly held or tied to a post or a tree, hard friction is applied to the ear to stimulate the circulation and render the artery more prominent. The concha is held by the left hand, with the index finger in front and the thumb behind the artery, the incision is made by piercing the vessel with the lancet held perpendicularly to the concha, the artery being cut directly across, and the incision enlarged by a downward movement of the instrument. This is followed by the appearance of a few drops of arterial blood, but which soon stops unless the flow is assisted, which is done by the operator, without releasing the ear, by striking light blows or *taps* with a small stick along the course of the artery between the incision and the animal's head. This last step is indispensable to obtain a good, free flow, *per saltum*, of course. This whipping process is continued until the stream becomes abundant, but may be suspended when it reaches that point, to be renewed again, however, if the hemorrhage diminishes. Artificial means to close the incision are not usually required, the flow generally ceasing spontaneously, but when that fails to occur a pin suture or a bandage at the base of the concha, or finally the ligation of the artery, if necessary, will effect the object. The animal must be kept confined for some time, to prevent him from rubbing the wound or shaking his head too violently.

In *swine*, this artery is so easily reached that it is often selected in preference to other blood vessels which may be more or less imbedded in the fat of the animal. The knowledge of its position is very important, as it is very small and difficult to find. Running vertically between the temporo-maxillary joint, it reaches the base of the concha, and passes by the side of its convex surface towards its point. It must be opened at the lower third of the cartilage, where it presents its largest dimensions. The artery must be cut transversely with the lancet. The bleeding ceases spontaneously, or, if necessary, may be treated in the manner indicated for cattle. (Fig. 449.)

(*c*) *Bleeding at the Median Caudal.*—In cattle this artery is quite large and very superficial. It runs along the inferior face of the tail, being covered at the base of that organ by the inferior

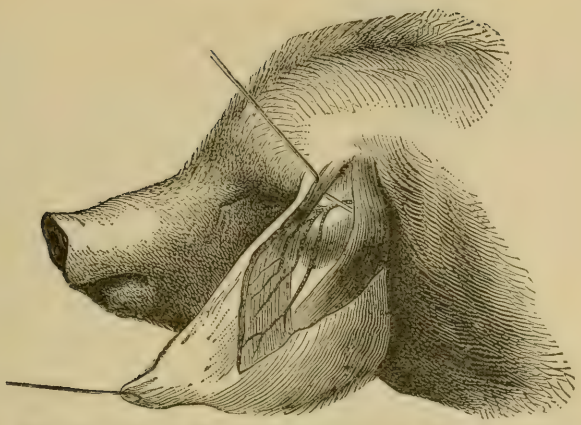


FIG. 449.—Anatomy of the Posterior Auricular Artery in Swine.

caudal muscles, then becoming superficial and readily accessible to the end of the member. In opening it, it is pierced by the lancet in the longitudinal axis of the vessel, the tail being kept elevated. Ordinarily, however, not only is the artery cut directly across, but the skin or surrounding muscular fibres are included. The incision must be made on a level with the superior third of the tail; higher up the operation may be complicated with abscess, disease of the vertebræ, sloughing of the tail, etc. If it becomes necessary to stimulate the flow of blood the same "whipping" process may be employed that was recommended in bleeding from the posterior auricular. A bandage may be applied round the tail to stop the hemorrhage, though it is not commonly needed.

A few practitioners prefer to operate with the fleam.

CAPILLARY BLEEDING.

The consideration of the operation which consists in the depletion of the minute extreme vessels naturally and logically follows that which treats of a kindred procedure with the veins and arteries. The intention of the treatment instituted for all is the same, and their curative effects are adapted to similar ailments. These are principally local, and may be divided into two classes, to wit: those which have been in a great measure discarded from general practice, and those which still retain their place in the domain of veterinary surgery. The former includes bleeding at the palate, the coronet, and the foot, and the latter comprehends

the punctures, the scarifications, the *ventouses*, or cupping, and the leeching, of regular current practice.

(*a*) *Punctures and Scarifications.*—These are methods of producing small superficial wounds through the skin and the subcutaneous cellular tissue, to obtain the effect of a local bleeding, or the escape of any other fluid contained in the subcutaneous substance. They are indicated against local swellings and serious effusions, or œdema of the cellular tissue. They can be applied upon any part of the body, and though they take effect in the escape of but small quantities of fluid, their action may be stimulated by additional local applications, such as warm poultices, warm water fomentations, or dry, stimulating frictions.

Punctures, however, are principally effective when employed to overcome œdematous swellings of the extremities, and of the genital organs, while scarifications are prescribed with better advantage to obtain the resolution of cold or chronic swellings, or to control the inflammatory process in cases in which the tissues are largely swollen and threatened with gangrene.

Both the bistoury and the lancet, and, in rare instances, the fleam, are used in fulfilling these indications.

In making punctures the skin and cellular tissue are pricked or pierced to the depth required, with the bistoury or lancet, by rapid thrusts distributed over the entire surface of the swelling, and when the fleam is used it is manipulated precisely as when used in bleeding, though, of course, with quick repetitions.

(*b*) *Scarifications* may be defined as rather small incisions, made with a convex bistoury, with which the skin is cut from without inward, in parallel series, but which, in some instances, when an increased effect is desired, are doubled by a second series crossing the first at an angle.

(*c*) *Cupping.*—This mode of obtaining capillary bleeding is very seldom employed in veterinary practice. The cups are, however, indicated in subcutaneous inflammations, accompanied with swellings, and resulting from blows, contusions, kicks, and other and similar traumatic causes, and are often preferable to blisters. They are recommended in arthritis, ostitis, and even in internal phlegmasia. They render valuable aid in emptying some forms of abscesses, and are credited with the possession of power to arrest or prevent the absorption of virus introduced into wounds or deposited on their surface.

There are two modes of cupping, the *dry* and the *scarified*, or wet. The dry cup consists in the simple application of the instrument upon the skin to produce a swelling, accompanied with more or less injection of the capillary vessels, and a local irritation, which generally rapidly subsides.

The operation of scarified cupping consists, first, in applying the instrument to produce the swelling, and when the tumefaction is sufficient following it with the scarificator. In completing the first step, which is the same as for the dry cuppings, several means are used. The skin being prepared by clipping or shaving off the hair, a small glass globe, filled with heated air, is placed over the spot selected for the operation. A small ball of wadding or oakum, either dry or moistened with an inflammable liquid, is placed in the glass and lighted, and as it begins to burn the glass is pressed upon the skin. To avoid burning the skin, *pumping*, or vacuum-cups, have been devised, some of which are provided with scarificating blades. These are, however, too complicated for our general practice. When the effect of the cupping is completed, the red and tumefied skin, which is exposed as the glass is removed, is scarified with instruments *ad hoc*, as the lancet or the bistoury, and the cup is immediately reapplied over the same spot. The blood then escapes freely from the incisions, and continues to flow until the cup is filled and removed.

(*d*) *Leeches* are not as frequently used in veterinary surgery as they might be with profit. They are well adapted to small animals, such as dogs, whose fine and vascular skin yields readily to their application. For applying them the skin is first smeared with a little milk, sugar, or blood, and the leech, placed in a small glass, or cup, or clean pill-box, is brought in contact with the skin by reversing the cup or box upon the chosen place. Usually it attaches itself at once, and remains until it becomes gorged with blood, when it voluntarily releases its hold. Sometimes, however, it is better to place them upon a thick compress, moistened with tepid water, and to apply this over the skin. In applying them on the leg it is a good plan to cover them with a cloth, secured with a string tied about the leg above and below, forming a sort of bag.

When the animal fails to drop off, after being thoroughly gorged, a sprinkle of salt speedily causes him to release his hold. The succeeding hemorrhage will ordinarily cease after a short

time without aid, but if it is desirable to continue it, the parts may be fomented with warm water, or covered with a warm poultice.

(*e*) *Bleeding at the Palate.*—Bleeding in this region of the mouth is done by a division of the capillary network which rests between the mucous membrane and the fibrous coat which lines the bones forming the palate.

The bones represented by the inferior face of the palatine process of the great maxillary bone, and the posterior face of the short process of the anterior maxillary, are covered with a fibrous coat, which extends over their whole surface and the cartilage that fills up the incisive slit. On each side of the palate run the palato-labial arteries, which, forward, form an arch, and anastomose together, and give rise to a single branch, which enters the incisive canal formed by the internal face of the two small maxillaries. The veins, which are very numerous, form a large network which fills the space left between these two large arteries. The whole is covered by the mucous membrane, which is white, rosy, thick, adherent to the fibrous coat, and showing a number of rugæ, about twenty, curved forward and diminishing posteriorly in size and prominence. Anteriorly they are very large, by reason of the presence of a certain amount of cellular tissue, which diminishes by degrees, from before backward. The anastomosis of the arteries takes place about on a level with the third rugæ of the palatine surface, and it is, therefore, posterior to this that the bleeding must be performed to avoid wounding the artery.

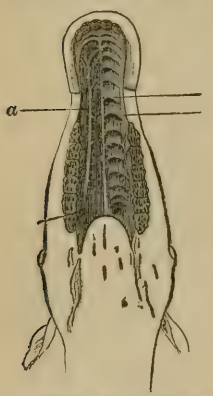


FIG. 450.—Circulation of the Palate. *m*, Palatine mucous membrane *s*, grooves of the palate; *a*, palato-labial artery.

The instrument required is the simple bistoury, or the one represented in figure 451. The operator, facing the animal, and holding the tongue with the left hand, draws it out of the mouth on the right side, and with the edge of the knife turned backward, makes a small incision from before backward, in the middle of the palate between the fourth and fifth rugæ. There is no danger of wounding the arteries if the incision is made at the proper place and on the median line. When that is the case, the hemorrhage, continuing for a variable length of time, subsides by degrees.

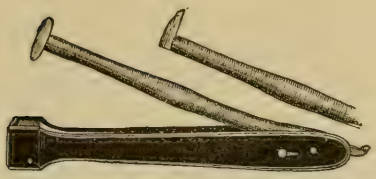


FIG. 451.—Lancet to Bleed at the Palate.

If, on the contrary, an artery has been divided and the flow of blood becomes sufficiently abundant and continuous to become alarming, it becomes necessary to employ hemostatic means. These may be a small sponge compressed or moistened with cold water or an astringent solution; or, if necessary, a pad of oakum can be applied and secured with a bandage passed through the mouth and around the maxillary bone, and tied on the face. It can also be accomplished by means of a peculiar bit, represented in Fig. 452. This bit has a small board in its middle, and on each side of the bar two straps, one to act as the check-piece of a bridle, the other being passed over the nose where they are buckled together more or less tightly. The board of the bar is padded, and is applied directly over the place of the incision. The pressure should be continued for several hours.

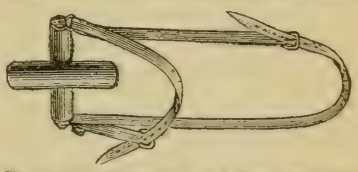


FIG. 452.—Apparatus to Apply Pressure to Stop the Bleeding at the Palate.

This operation was first recommended in cases of stomatitis, in the peculiar form known by the unmeaning name of *lampas*, but is resorted to for a much better purpose in apoplectic congestion of the head.

(*f*) *Bleeding at the Coronet.*—In the "Dictionary of Veterinary Medicine and Surgery," Bouley says: "There exists on each side of the coronet, a rich superficial venous plexus resting on the cartilaginous plates of the foot, formed at this point by the union of numerous veins of the digital region. These veins are united by large communicating vessels, running on the anterior and posterior faces of the second phalanx. Nothing is easier than to open one of these vessels by plunging the point of a bistoury through the skin; the puncture being followed by an abundant flow of blood, and, if it is repeated, a large bleeding, quite as abundant as that obtained by the opening of another large vein,

can be gained. But it is not a matter of indifference whether the puncture is made in front or behind, or upon the sides of the region. It must never be made on the sides, because of the danger of injuring the cartilage, several cases of cartilaginous quittor having been known which were attributable to no other cause than bleeding on the side of the coronet. In front the operation is less dangerous, although a wound of the tendon of the anterior extension of the phalanges is possible. It is safer to bleed on the posterior part of the coronet, where no danger can be looked for.

This bleeding has been principally recommended as a local operation in cases of acute laminitis.

(*g*) *Bleeding on the Foot.*—The toe is the part selected when bleeding is performed on the foot. It is an operation which has been known for many years, and under various forms, and with different applications has been described by Virgilius, Columelle, Absyrtus and Vegetius. It consists in the incision and removal of a portion of the sole of the foot. It is indicated in all cases where local bleeding is justified, and has, therefore, been recommended in all congestions and inflammations of the foot, such as bruises, burned soles and acute laminitis, though in this last case its execution is rendered difficult by the unwillingness of the animal to support its weight on one leg during the operation. There are several ways of bleeding at the toe.

1st. *The Chabert Method.*—A special shoe must first be prepared; it may be simply an ordinary shoe notched on its inner border, which, without being removed, permits both the operation of bleeding and the subsequent application of a dressing. In operating, the sole is pared out and a groove made between the point of the frog and the toe of the wall, with a drawing-knife, until the soft tissues are reached. An incision is then made with the curved bistoury at the bottom of the groove, between the wall and the inferior border of the os pedis, and an incision made dividing all the vessels that come in contact with the instrument. When the flow of blood has been sufficient, the hemorrhage is suppressed by a compressing dressing of oakum kept in place by bandages, or with plates, according to the condition of the foot, and whether it had been shod with the notched shoe, or had remained entirely shoeless.

FIG. 453—Shoe for the Bleeding at the Toe, according to Chabert's Method.

2d. *The Valet Method.*—After the preparation of the foot, as with the other method, a groove is made. It is posterior and parallel to the line which marks the separation of the wall and the sole, and the incision is made transversely, with a bistoury or a sage-knife. It is usually followed by a good flow of blood. An ordinary shoe is then placed on the foot, and a compressing dressing of oakum put on and kept in place by plates.

3d. *Crepin's Method.*—The difference between this and the other processes consists in making the incision with a narrow drawing-knife, which provides a larger opening for the escape of the blood. A wide-webbed shoe, with a padding of oakum over the wound, suffices to control the hemorrhage.

All of these methods have the same object in view, but many veterinarians prefer to make the incision a little back of the line separating the sole from the wall, and right at the toe, and they sometimes remove a small portion of the sole with the sage-knife or the bistoury.

The dressing which is required in these cases must be carefully applied, as protruding granulations may sometimes make their appearance, and interfere with the cicatrizing process. If the hemorrhage which accompanies the operation should be considered insufficient, it can be stimulated by placing the animal in a foot-bath of blood-warm water.

SURGICAL HEMOSTASIA.

The extraneous hemorrhage, whether it be avoidable or unavoidable, which may occur during an operation, forms one of the most embarrassing of the interferences to which the surgeon is liable, not only from the difficulties it interposes in the way of the success of the operation, by disturbing his manipulations, but as well, sometimes, by the effect of the loss of blood upon the patient. It may happen, indeed, that instead of ceasing spontaneously, or yielding to the effects of the ordinary dressings, the hemorrhage becomes so obstinately persistent as in itself to constitute a serious, and, if unsubdued, a fatal accident. It becomes necessary therefore for the operator, as one of the practical elementary incidents of his calling, to be always prepared in an emergent case to arrest the rebellious circulation by prompt and efficient measures. Hemorrhage being an essential danger in all

operations of considerable magnitude, the means of subduing it should always, especially in cases of that class, be included among the customary instruments and appliances of the working surgeon. The flow may proceed from any of the blood vessels, the arteries, however, from the nature of their functions and the force of their action, requiring more frequently and more particularly the application of precautionary and remedial measures.

Temporary or Preventive Hemostasia.

This becomes necessary as an occasional expedient, when the presence of the blood is likely to become an obstacle to the operation, and the preventive means may be applied either before or during its performance. Included under this general head is the circular compression, or ligation *en masse*, when the situation and the form of the region render it practicable. The effect of this being the flattening or collapse of the vessels, and the temporary closure of their calibre, one of the necessary conditions of its successful application, especially with the superficial vessels, is that they should be situated near enough to some structure sufficiently hard and solid to furnish an unyielding *point appui* to the compressing agent. If, from the position of the artery, no such point of resistance can be made available among the surrounding parts, resistance can be established by a double pressure made in opposite directions, in such a manner that the compressing powers can furnish mutual support, each to the other. By this plan compression can be effected in four different ways.

1st. *By Digital Pressure.*—When this can be applied and proves sufficient, it is the simplest and the best mode. While it serves to obstruct the circulation, its action is limited to the vessel which alone needs it, and the tissues are not contused by the pressure; it can, moreover, be suspended or renewed at will, and can be managed by an assistant who may be placed in a position in which interference with the operator can be entirely obviated, and, indeed, can sometimes be performed by the surgeon himself. It is obtained by pressing the vessel with the tips of the fingers placed either vertically upon the vessel itself, or along its course; and only such a moderate degree of force need be employed as will prove sufficient to close the calibre of the vessel, without fatiguing the hand by unnecessary pressure.

2d. *Compression with the Circular Ligature.*—Either a bandage or a circular string of sufficient strength may be employed in this method. If needed upon the leg, it should be placed upon the lower part of the limb, either dry and moderately tight, or moistened with cold water. If kept in place for a certain length of time previous to an operation, the effect will be to so reduce the force of the circulation in that part as to render the performance comparatively a bloodless one. This proceeding is often associated in veterinary practice with the operation of neurotomy. In operations upon the foot, comparatively perfect hemostasia may be obtained by circumscribing the coronet with a ligature

FIG. 454.—The Adstrictor of Brogniez.

formed of a strong circular string, tightly drawn, but as a substitute for this, a special instrument has been invented by Brogniez, which he calls the *adstrictor*, which secures the same results.

3d. *Compression by the Tourniquet.*—The adstrictor of Brogniez is but a peculiar form of tourniquet, which is composed of two oval cushions or pads supported by metallic plates, and secured on the inner face of a circular band adjustable as to its

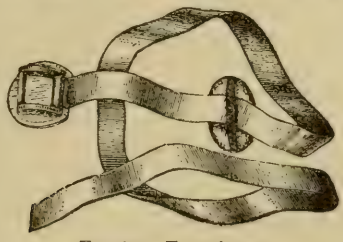


FIG. 455.—Tourniquet.

length, and secured by a common buckle. This band is buckled around the leg, and the pressure is made by the pads, which are laid directly over the course of the vessel.

4th. *Compression by Esmarck's Method.*—Another mode of compression, borrowed from human surgery, that of Professor Esmarck, is designed to wholly prevent the loss of blood, and enable the surgeon to perform a perfectly dry or bloodless operation. It

consists of a roller of India rubber, to be so applied around the seat of the operation as to cause the blood to recede toward the center of the body, its return being prevented by firmly placing a ligature just above the point of incision. The pressure produced by this band can be regulated by means of a tourniquet, or a piece of elastic tubing, or an ordinary string that may be twisted with a stick. This mode of compression is adapted to cases of amputation of the limbs and of the tail, or the removal of tumors.

Permanent, or Definite Hemostasia.

The arrest of hemorrhage may become necessary at any step of an operation, but it is ordinarily when it has been completed that the indication must be fulfilled. It is true that in many instances, even after extensive lesions, the hemorrhage will cease spontaneously, but it is equally true that at other times special interference becomes a necessity. If the hemorrhage is capillary, the surgeon may safely overlook it, and leave it to subside under the influence of the retractility of the tissues; but if it is of venous origin, it cannot be safely left to spontaneous action. Still, usually it is only when one of the larger veins is the seat of the bleeding that danger becomes imminent, as with those situated near the center of the circulatory system; but serious accidents are seldom to be feared. If the vein is cut across, moderate pressure upon the orifice will generally insure the formation of a clot which will constitute a sufficient plug, or if the vein is opened longitudinally by a lateral incision, pressure at the point of the wound, though not strong enough wholly to stop the circulation within the vessel, may still be sufficient to assure the rapid obliteration of the wound. But when large veins or arteries are opened, or even when the capillary hemorrhage is usually abundant, more complicated means of hemostasia must be resorted to, and not only applied carefully and securely, but also with celerity. The means of obtaining permanent hemostasia are of two kinds—one taking effect through the *physico-chemical action* of special agents, the other including those which are known as *surgical means* proper.

Physico-Chemical Hemostatics.

Among these must be considered the *refrigerants*, *absorbents*, *astringents* or *styptics*, and *potential* and *actual* cauterization.

1st. *Refrigerants.* — The agents included in this class act almost exclusively by depriving the parts upon which they are applied of their heat, and in producing a certain excitation upon the vaso-motor nerves, followed by a toxic contraction of the muscular fibres of the vessels, and the diminution, or sometimes the complete arrest, of the bloody flow. Their action is principally efficacious on vessels of small calibre, such as the capillaries.

Cold water, snow, cracked ice, and the very volatile liquids, as ether, chloroform, and freezing mixtures, fill an important place in this category. In veterinary surgery, cold water, being the simplest, the most accessible and abundant, and the easiest to apply, heads the list. It is used in the form of douches, baths, lotions and injections, or by means of compresses, pads, or cushions of oakum laid upon the seat of hemorrhage. The saline mixtures, and the snow or cracked ice, are placed in cloths, bags or bladders, but their action must be watched in order to obviate the possibility of congelation and mortification of the tissues, quite a possible result of excessive refrigeration.

Refrigerants are generally considered as forming the least effective of hemostatics, but their facility of application has brought them into common use. They are principally indicated against external capillary bleeding, or that which escapes from a small vessel, but would generally prove insufficient against a hemorrhage from a large vessel. They may, however, prove advantageous against some internal hemorrhages, which, though they may be controllable by other direct means, yet can be reached by the water without difficulty or danger, and act directly or by continuity in producing the necessary contraction. In this manner, injections into the nasal cavities, or the uterus, or rectum are often efficacious in arresting a hemorrhagic flow suddenly occurring. But in any case, refrigerants should be applied with care, and their effect watched. If they are allowed to remain too long in place, or the temperature be too low, they may induce an inflammatory reaction and local gangrene, or produce other dangerous general effects upon the internal economy. On the other hand, if imperfectly applied, and without a sufficient degree of cold, their action, already weak, will become a mere useless negation, if not worse. Between these two extremes there is a middle course, which the competent surgeon will be able to observe by exercising his discretion, and an appeal to his own experience.

2d. *Absorbents.* — Hemostatic absorbents proper are agents which by their capillary action suck up or soak in the sanguineous element from traumatic surfaces, and having their structure thickened and condensed by the presence of this contained liquid, coagulated in their mass, oppose thereby an invincible obstacle to the escape of the blood. Oakum, charpie, punk, spider-webs, flour, fuller's earth, sponge, and various vegetable powders belong to this catalogue of medicaments. Oakum, which is the substance which meets with general favor and is most commonly used, is applied in the form of balls, dry, or soaked in cold water, and packed over or into the depth of a wound, and kept in place with bandages or compresses.

Compressed sponge has proved, in our hands, an excellent hemostat, not only in capillary bleeding, but in that also of medium-sized vessels. There is, however, an objection to its use in the fact of its liability to become adherent to the tissues with which it is in contact, and the consequent danger of renewing the hemorrhage when removing it.

3d. *Astringents, or Styptics.*—These agents produce the coagulation of the blood, by a chemical action, resulting from the combination of the astringent's substance with the living tissues. Their action differs essentially from that of the refrigerants in the fact that they possess the special property of producing, by their power of fibrillar astriction, the occlusion of the vessels through the coagulation of the blood in their interior.

Astringents are used in both the solid and the liquid form. Burnt alum in powder, and certain vegetable powders, belong to the first class. The solution of sulphate of iron, sulphate of copper, alum, acetate of lead, alcoholized water, solution of tannic acid, etc., are included in the second. They must be judiciously used, however, because of their liability sometimes to excite local inflammations, more or less active. The action of the liquid astringents is deeper, more energetic, more lasting, and more durable than that of the solid, and they are for that reason sometimes more reliable for the control of hemorrhages from large vessels. Their consistency renders them, of course, alone available for moistening compresses, balls, the tampon, or pads of any description. The most powerful of this class is the perchloride of iron, which is remarkable for its power of coagulating the blood almost instantaneously. When applied with oakum upon a bleeding sur-

face it forms, with the blood, a blackish magma, and a resisting, strongly-adherent clot in the cavity of the vessel.

4th. *Potential Caustics.*—The chemical astringents have generally the same mode of action. Upon being placed in contact with the tissues they enter into combination with their elements and form a coagulum, and it is the presence of this clot which produces the hemostatic effect. They are but little used, however, in veterinary practice. The nitrate of silver, some of the mineral acids, as sulphuric, nitric, or arsenious, or bichloride of mercury, are the potential caustics which are occasionally used, though it should always be with great caution, in view of the possible danger of producing an excessive effect.

5th. *Actual Cauterization.*—Cauterization with the hot iron is the oldest and principal hemostatic in use in the surgical treatment of the domestic animals, and in many instances may be made to supersede all the chemical agents we have considered, more especially in cases of capillary hemorrhage. It is applied with the iron heated to a white heat, and laid upon the bleeding surface, where it immediately creates a thick, impermeable eschar, adherent to the wound, and offering an insurmountable barrier to the escape of the blood.

To obtain all the effect desired the wound must be thoroughly free from all extraneous substances, liquid or solid, that nothing may interfere with the rapid formation of the eschar. The blood should be well soaked out, a plug of oakum firmly pressed upon the wound, and the iron pressed perpendicularly upon the tissues; this rapidly forms the eschar. The application of the cautery must be continued for a few seconds only, on account of its liability, while cooling off, to adhere to the tissues and to the eschar, with the consequent risk of reopening the wound and renewing the hemorrhage upon attempting its removal. It is better if the eschar is not sufficiently thick, after a first application, to renew it a second, or even a third time, always taking the same precautions, and being careful to avoid contact with sound tissues.

In this operation it is essential that the temperature of the cautery should be at its maximum. Half-heated, or cooled off by the blood, not only is the application more painful, but the effects are incomplete and the hemorrhage is likely to return. If the blood escapes too freely, or coagulates too slowly, the eschar not forming, it may sometimes become necessary to carbonize the

bleeding surface by means of some combustible substance which will furnish more solid materials for the protective scar. A loop of hair, or some pulverized rosin, placed upon the wound, and burnt with the cautery, often fulfills the requirements. For hemorrhage from parts below the surface, the edges of the wound must be separated before the cautery is introduced, to prevent its cooling before reaching the proper point of application. When the eschar is well formed and established it should be left without interference to complete the process of sloughing.

The thermo-cautery, with which the required heat can be retained at a uniform degree, is one of the best instruments for the application of this mode of hemostasia, there being no need of removing it until an eschar of sufficient thickness has been obtained.

Surgical Hemostatics.

Among the numerous surgical means of obtaining both permanent and definitive hemostasis, there are three which principally merit our attention: *compression*, *ligature* and *torsion*.

(A) Compression.—We have already referred to this method while considering the subject of temporary hemostasia. There are cases in which it acts as an excellent mode of permanently controlling hemorrhage, whether proceeding from arterial, venous or capillary sources, and equally whether from a large surface or from a deep cavity, where the origin of the hemorrhage cannot be distinctly located. Still, for arterial hemorrhages it is only efficacious for vessels of small or medium size, or when the wounds are of small dimensions. There are secondary circumstances which determine the designations of certain variations of pressure. One is the situation of the vessel, relatively to that of the bleeding orifice, when the pressure, to be effective, must therefore be *direct* or *lateral*, and with the latter, either *mediate* or *immediate*. Sometimes, again, it is applied at a distance from the bleeding point, and in an indirect manner, and involves an alternative between *plugging* and *direct compression*. It is applied to the wound itself when the vessel has been cut directly across. It is usually effected by covering or filling the wound with a dressing of balls of oakum applied directly upon the bleeding orifice, and covering these with pads, increasing in dimensions as they become more superficial. The whole apparatus is submitted to pressure

by approximating the edges of the wound, as much as possible, by means of interrupted, pin, or a quill suture; or sometimes a circular bandage of dry or compressed sponge, cut into small pieces, may be used in the same manner as the oakum with excellent effect, especially when the hemorrhage is abundant, or ligation become impracticable.

The objection to the mode of compression, generally speaking, is its liability to become loosened in consequence of the softened and yielding condition of the surrounding tissues. For this reason the mode of applying the force directly is not often practiced, or, at least, is adopted only when the hemorrhages are small and controllable by slight pressure, or in case of the section of an incompressible artery, like that of a bone.

In order to increase the effect of direct pressure the surgeon sometimes has recourse to the joint use of some of the physico-chemical hemostatics before mentioned.

(*a*) *Immediate Lateral Compression.* — This is practiced against hemorrhages due to lateral wounds of blood vessels, and is applied directly upon the opening in the vessel. The method of its application does not differ from that of direct compression, and it is liable to the same objections in its irritating effect upon the surface of the wound and consequent interference with cicatrization, and the danger of a renewal of the bleeding. Moreover, if the vessel is without a solid resting-place, and there is no sufficient resisting point, hemorrhage is not arrested. But again, in a contrary condition, it may be followed by gangrene or the obliteration of the vessel, and if the wound is of such a form that this last accident cannot be avoided it is better to have immediate recourse to the ligature. It remains, then, that this mode of hemostasia is only advisable when the wound is small and the artery small and superficial, or in such a position that it cannot be ligated.

Immediate lateral compression, however, can be made with great benefit with the finger upon the wound, pressing with the necessary force to prevent the escape of the blood, without closing the calibre of the vessel. The finger is kept in position for one or two hours, with an occasional inspection to discover whether the hemorrhage has ceased, and when it is removed there remains but a simple wound, easy to dress.

This mode of compression has the advantage of obviating the accidents that may occur from excessive external pressure main-

tained by ligatures and dressings, such as the division of the skin and the possibility of gangrene. The value of this measure of digital compression may be estimated by the fact of its successful application to a vessel of the dimensions of the carotid artery in a case of a wound by pricking.

(*b*) *Mediate Lateral Compression.*—The compression here is applied outside of the solution of continuity, in such a manner as to leave a certain thickness of the tissues between the injured vessel and the compressing apparatus. It may take effect either directly upon the wound itself, or elsewhere along the course of the vessel. It can be effectively made only upon superficial vessels, principally arteries which, like those of the extremities, lie upon or near enough to resisting surfaces to furnish a means of support to the pressure. The manner in which temporary and permanent hemostasia can be obtained is the same, excepting that the cords, bandages and tourniquet are replaced by graded compresses, supported by rollers or appropriate bandages, which are continued only during the existing necessity.

The objection to this hemostatic method, and which it shares with all the other processes of compression, is, that when a large vessel is to be compressed, and a certain amount of force becomes necessary, other tissues, with other vessels, veins and nerves alike, must participate in the same pressure, and, as a consequence, disturbances of varying degrees of severity will occur in parts situated beyond the compressed surface, proportioned to the duration of their exposure to the acting cause. Hence the indication, in applying the apparatus, to begin at the peripheric portion of the region, to carry it toward the center, in passing over the wound already protected and covered by the balls, pads or compresses, which constitute the true means of compression.

The principal objections to this process of hemostasia can be obviated by leaving on the apparatus only for the minimum time necessary to obtain the cicatrization of the wound of the vessel, which will, of course, vary according to circumstances, and will be especially influenced by the consideration whether the calibre of the vessel is to be preserved or obliterated.

If the vessel be a small one, the wound of small dimensions, and the continuity of the channel is to be preserved, a few hours will be sufficient; or, if otherwise, it is to be obliterated, one or two days will be required, or even at times one or two weeks.

(*c*) *Plugging.*—This mode of compression is chosen as a permanent hemostatic to arrest hemorrhages which occur upon the surface of natural cavities, or upon wounds where the injured vessel cannot be reached. This is done with balls, or pledgets of oakum or sponge, carried with a forceps to the bottom of the cavities, or with sachets, arranged in the manner of the tampon, impregnated with an astringent solution or a cold mixture, the whole being kept in place by the dressing which closes the cavity. It is used in cases of epistaxis and hemorrhages from the uterus, or those following castration. But with all its advantages it is an uncertain mode, and opposes but a slight obstacle to the hemorrhage; besides which it irritates, by the pressure of the plugging material on the parts with which it is in contact, where it acts in the manner of a foreign body, which in fact it is, giving rise to some pain, and perhaps stimulating muscular contractions, and thus exciting the hemorrhage anew. However, these objections are not of sufficient weight to contra-indicate its employment as a ready and efficacious means of hemostasia, or to prevent it from being wisely appreciated and largely employed by the surgeon.

(B)—Ligature.—The ligature is the typical and obvious means of hemostasia—the hemostat *par excellence*—perfect in its simplicity, though consisting simply in tying a circular thread or cord around the wounded vessel with sufficient tension to close its channel, suppress the circulation, and convert the tube into a cord. It can be applied either on the cut extremity of an artery, or upon its continuity. It is seldom applied upon veins, however, from its liability to induce phlebitis, but still, it is resorted to in wounds of large veins, or when the hemorrhage cannot be controlled by other means.

As with compression, ligature may be *immediate* or *mediate*, and may also be divided into *temporary* and *permanent*—*temporary*, when its continuance depends upon some contingency—*permanent*, when it is to remain until it is eliminated by suppuration, or becomes organized and absorbed, as when the ligating thread is composed of some special animal fibre—which is the kind most commonly used.

The instruments required for this operation are: tenaculum, aneurism needle, ligature materials, ordinary dissecting or bulldog forceps, scalpel or bistoury, and the grooved director.

The kind of forceps used are known as artery forceps, and are of numerous varieties.

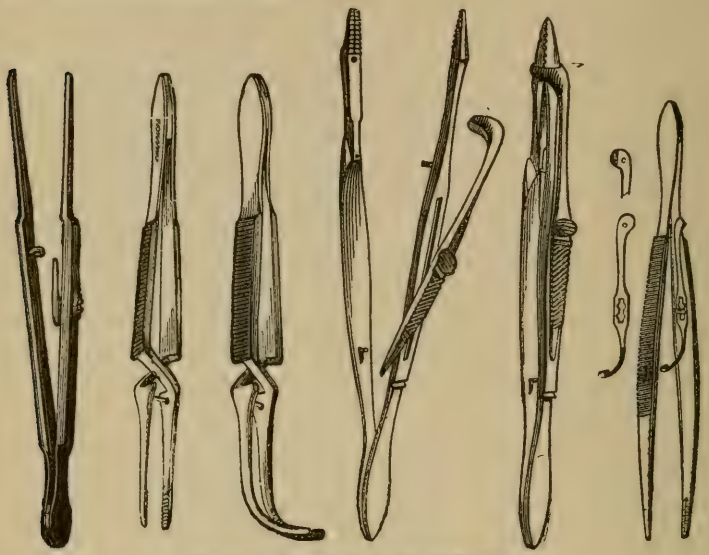


FIG. 456.—A variety of Artery Forceps.

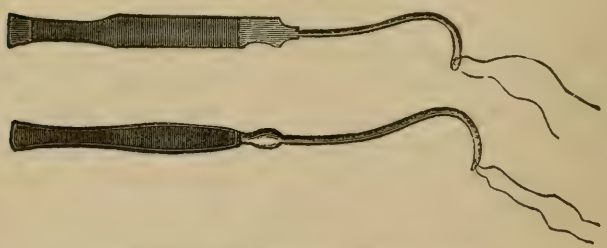


FIG. 457.—Cooper Needles, or Tenaculum.

The tenaculum, or aneurism needle, is a kind of blunt tenaculum with an eye at its end, and is used to seize or secure the vessels.

The suture materials are linen thread, silk, animal ligatures, such as catgut or tendinous fibrilla, and sometimes very fine metallic wire. Ordinary linen thread and silk, well waxed, are most commonly used in veterinary practice.

(*a*) *Immediate Ligature.*—This is the surest of hemostatic means. It is applied principally upon large arteries surrounded only by their cellular sheaths, and a difference is made in applying

it between vessels which are perfectly intact and those which have been partially cut through or otherwise injured.

The *immediate ligating of an artery entirely divided* includes but two steps: the prehension of the artery and the adjustment of the ligature.

When drawn out of its position with the proper forceps the artery must be carefully examined for possible adhesions, and especially any nervous threads which may be attached to its surface—all of which must be dissected.

In placing the ligature many operators carry the thread, forming a loop, with the forceps, and on seizing the artery and seeing that it is clear from the surrounding tissues, they slip the loop down over the instrument upon the vessel, to be tied by an assistant. The apparent simplicity of this movement is deceptive; too often the loop of the ligature adheres to the wound, the ends roll over themselves and one another, the ligature cannot be properly placed over the vessel, and the knot is tied over the forceps before the thread has reached the artery. To avoid this it is better, when the vessel has been well secured and isolated, to have the assistant apply the ligature by its middle upon the jaws of the forceps, behind the hand of the surgeon holding them, in order to be free in his movements. Then making first a simple knot, without twisting the thread, and tying it close to the forceps, he then, with the

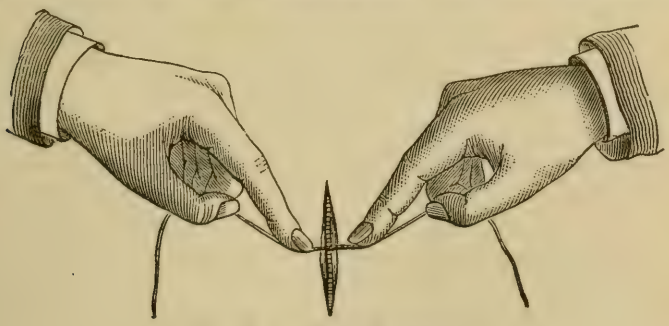


FIG. 458.—Applying the Ligature.

thumbs, pushes the thread further along the artery, and ties it by pressing the thumbs together with sufficient firmness to rupture the internal membrane of the vessel. If the wound be deep, instead of the thumbs both indexes are used to carry the thread along the artery and tie it. The forceps is then removed and

FIG. 459.—Straight Knot.

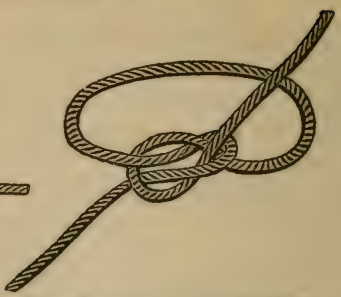


FIG. 460.—Improperly-made Knot.

a second straight knot is made (Fig. 459). The knot represented in Fig. 460 is improperly made and liable to become loosened. The extremities of the thread are left of a sufficient length to allow their being turned toward the most dependent part of the wound. If they are cut too short they are liable to become *loose* in the tissues, and be covered or concealed by the granulations and become the center of a suppurative gathering. Ligatures intended to remain in the tissues, must be made of animal material.

The wound of an artery always involves the application of a ligature on both extremities of the course, the central and the peripheric.

Where the artery cannot easily be raised or dissected from the tissues into which it is retracted, the pointed tenaculum can be used to draw it out of its position; this instrument is more suitable for small than large vessels, the coat of which it is liable to tear.

In the *immediate ligating of an intact artery, and without a solution of continuity*, the vessel is exposed by means of an incision, either parallel or sometimes oblique, and at others perpendicular to the artery, according to its situation and the nature of the subjacent tissues, carefully noting any projections of the bones, muscles, or tendons which can be made available as points *de repère;* observing, indeed, all the anatomical connections existing between the different structures. When the artery has been nearly reached, in order to avoid injuring it, it should be separated by dissection with the forceps and the bistoury from the tissues covering it, or by introducing a blunt, grooved director under them, as a guide, and dividing them with the knife. The sheath of the vessel is also carefully divided and separated from the vessel itself, which is then carefully isolated from its vein or surrounding adhesion, and the blunt-eyed tenaculum, or the aneurism

needle passed under it. Sometimes this is easily done, but in other cases the density of the connective tissue surrounding the artery is too great to allow the needle to pass readily under it, in which case the obstacle can be removed by scraping it away with the finger-nail, which will obviate the application of extra traction upon the vessel. The ligature can then be adjusted around the vessel by means of the tenaculum, and the operation completed as usual.

(*b*) *Mediate Ligature.* — This operation comprises including in the ligature of the vessel a certain portion of the surrounding tissue—a portion which should be as small as possible.

It is done with a curved needle and a ligature of single or double waxed thread or silk. The needle is introduced into the thickness of the tissues, at a small distance from the artery, and passed around it with the ligature, which should be firmly tied in the usual way.

The ligature is quite painful in consequence of the pressure it makes upon the nervous fibres which accompany the artery, and it is less safe than the immediate operation, exposing the vessel during its performance to the risk of wounds from the needle, and requiring, besides, a stronger traction upon the ligature and the knot, from the increased bulk of tissues involved; and there is, again, great uncertainty as to securing a sufficient division of the internal and middle coats of the artery. For these reasons it is less adapted to large than to small arteries.

The effects produced by the application of a ligature are not wholly mechanical. It is also followed by certain peculiar changes in the condition of the vessel, and by specific inflammatory phenomena which result in the permanent obliteration of the tubular character of the artery.

When an artery is tied with the ligature the internal and middle coats of the vessel are also divided by the compressing thread, and by their retraction above and below it they form a double cone, the apices of which rest on the ligated spot, the external coat resisting and arresting the flow of the blood. A clot is then formed, and the irritation produced by the pressure of the ligature stimulating the proliferation of the cellular elements of the walls of the vessel, adhesions are soon established between them and the coagulated blood, and the termination is the solidification of the former tube.

The presence of the ligature and its effect on the surroundings of the blood vessel give rise to a process of elimination, by which, after a certain time, the ligating thread is expelled, carrying with it the vascular stump situated beyond the ligature. At the same time, and while these phenomena are taking place outwardly, the clot, adhering more and more to the vascular surfaces, soon becomes the seat of peculiar absorbent changes, and gradually diminishing in size, at length disappears.

As the resorption of the clot takes place the walls of the vessel contract until at length the caliber of the artery becomes entirely obliterated, and the former tubular canal is transformed into a fibrous cord, extending from the point of the ligature to the nearest collateral vessel.

This obliterating process of the arterial canal may, however, be defeated by the interference of too active an inflammation, producing the premature sloughing of the ligature, or by the existence in too close proximity to the point of ligation of a collateral arterial branch. In both cases hemorrhages may follow; in the first, because the adhesion of the clot is imperfect, and in the second, because no clot has been formed.

(C) Torsion.—This hemostatic process has been known from an early date, but was not methodically described until about forty or fifty years ago, by Amussat, who recommended it in preference to the method of ligation. But daily experience has demonstrated its inferiority, and proved it to be a less powerful hemostatic measure than that of the ligature, and, moreover, that it is only available for hemorrhages occurring in small vessels.

There are several ways of applying torsion. Among the principal is that recognized by Amussat. It requires four forceps, two ordinary *anatomical*, another whose branches are terminated by smooth cylindrical jaws, and the fourth the *artery-twisting forceps*. The artery is held with one of the ordinary forceps; with the other the tissues surrounding it are separated from it; then the twisting forceps grasp the artery at its extremity in place of the one first used, keeping it out of the wound, and when thus secured the instrument with the smooth transverse jaws is applied above it, close to the tissues, and firmly pressed upon the coats of the artery. In this position, the twisting forceps is given a rotary motion upon its axis, as if the vessel were to be rolled over its extremities, and is twisted upon itself by seven or eight

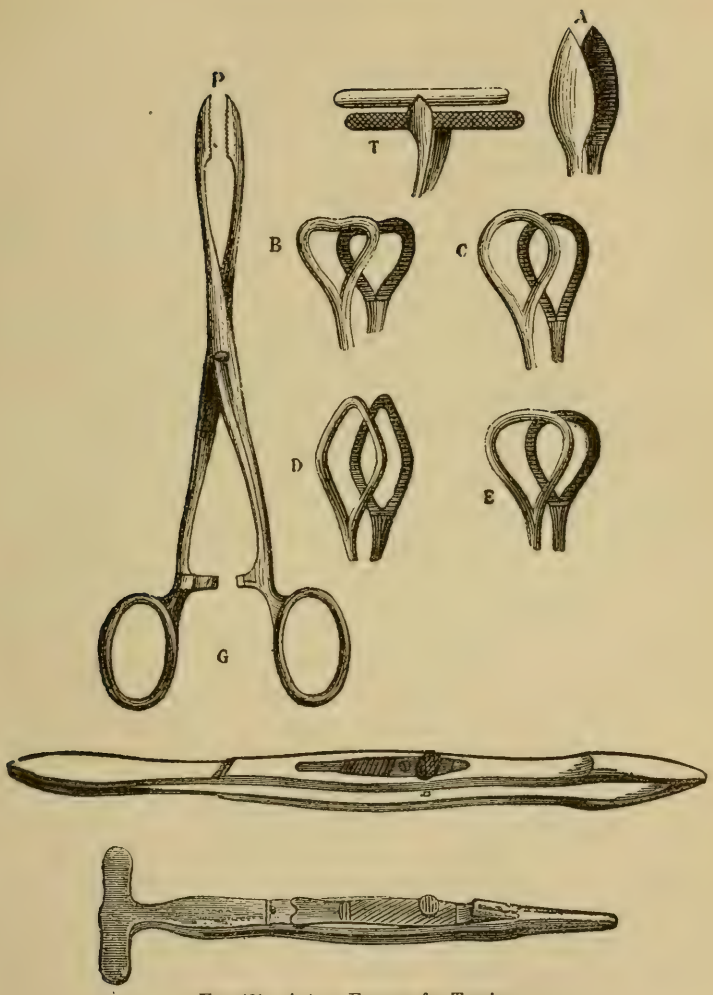


FIG. 461.—Artery Forceps for Torsion.

turns. The smooth-jaw forceps is then removed, and the stump of the artery is released and pushed into the tissues, unless the torsion has been sufficiently severe to produce the laceration and retraction of the vessel. As the result of these manipulations the two internal coats of the torn artery retract upon themselves and the external coat is elongated and rolled upon itself—all in such a manner that the clot is arrested by the retracted internal mem-

branes, as well as by the support contributed by the pseudo-plugging, which results from the twisting of the external coat.

This process is a complicated one, but it has been modified in several ways. In one process only *two* ordinary artery forceps are used; one applied at some distance from the end of the artery, transversely to its axis, and the other holding the vessel by its end in continuity to its length. Keeping the first tight on the vessel, the torsion is made by ten or twelve complete rotations of the second.

Another still simpler mode consists in grasping the mouth of the bleeding vessel, and giving it a number of rotations with a strong artery forceps, the artery being thus twisted without tearing or entirely dividing it. Nothwithstanding all these modifications, torsion is not applicable to large arteries, and cannot supersede the ligature. It is slower in performance; it is more painful; it requires a greater isolation of the vessel; and the possibility of untwisting, and with it, secondary hemorrhage, is always to be feared.

CHAPTER XI.

OPERATIONS ON THE NERVOUS SYSTEM.

PLANTAR NEUROTOMY.

Although the word *neurotomy*, when correctly defined, means, in a general sense, the *dissection of nerves*, it has in surgery another signification, and is applied indifferently to describe the division, the resection or the amputation of a nerve, according to the special manipulations of a given case. In veterinary surgery, it is held to be strictly applicable to the operation which consists in the dissection and removal of a portion of a nerve, and as the present chapter proposes to treat principally of affections of the foot, it is simply correct to employ the term *plantar* as a prefix to the title, as we have done. The design of the operation is the destruction of the susceptibility of the region or organ implicated in the treatment, and to subdue the pain, if not permanently, at least for a period of time sufficient to restore a working animal to his ability to labor, which, without such a relieving operation, would have been lost to usefulness and comfort.

This curious and important operation has a comparatively recent history. It is of English origin, two British surgeons claiming priority in its performance. These rival contestants are Moorcroft and Sewell, who put it in practice, the former in India, and the latter in England, at about the same time. After its introduction, it was frequently performed by English veterinarians, among whose names occur those of Goodwyn, Coleman, Percivall, Spooner and others.

Its introduction on the continent was in France, and is credited to Girard, Jr., who described it in 1824, and from that date it continued to be a subject of experiment at the hands of many veterinarians. We say *experiment*, because it was only after a

long series of trials, and as the result of much discussion of its merit and value, that it secured an affirmative verdict from the magnates of veterinary practice, and became an established position in our science. Yet the objections which it encountered in Europe have not to this day been wholly eradicated, and on this side of the Atlantic there are few practitioners who still decline to give it their confidence and adopt it in their practice. The opposition which it has encountered is founded principally upon the failures, the accidents and the unfortunate sequelæ, which were not rarely met with during the period immediately following its original introduction. These objections we now proceed to consider.

Stumbling has been mentioned as one of the first effects of the loss of the tactile function of the foot, by the destruction of its sensibility. The animal which has lost the solidity and the certainty of his gait, will only after a long time become accustomed to the proper use of the comparatively inert mass represented by so indispensable a part of his organization as his foot, so complicated in its arrangements and adaptations, and so perfect a portion of his anatomical structure before the extirpation of its nervous sense. And yet, while this condition of stumbling must be fully appreciated by those whose anatomical knowledge enables them to take into full and careful consideration the physiology of the part, and who have verified the objection from their own observation, there are also veterinarians of large practice and long experience who have operated in numerous cases, even upon animals used for fast work, where the muscular effort is of a comparatively violent character, who have met with the accident only in very rare and strictly exceptional cases. It must rationally be inferred that an unskilled operation of such a character would leave the patient in a condition of which an awkward and stumbling gait would be but a natural and inevitable sign. But it would also be in the course of a natural and healthy reaction for a horse to educate himself rapidly to the situation, and acquire a new certainty of movement and confidence in the use of his feet, which would soon restore him to his former ability to labor.

The *casting off* of the hoof, as a complication or termination of the operation in neurotomized horses, is one necessarily of a fatal character. This fatality has, in some instances, followed the

operation within a period of from one to two months, but on the other hand its occurrence has been deferred in other animals for years. Evidently, these varying results must be considered as the effect of different and quite disconnected causes. The truth is, indeed, that in the first instance it is due to a gangrenous disorganization of the tissues within the foot, and in the second, instead of being the result of insufficient vitality, or arising from lack of nutrition of the parts, it is more probably the consequence of the unregulated force of the concussion when the foot strikes the earth—unregulated because of the loss of the discriminating instinct formerly exercised, but now lost with the missing nerve-consciousness which once controlled all the movements of the limb. It could scarcely happen that such a condition of things should fail, after years of continuance, to encounter some susceptible temper in which to exhibit its baleful influence.

A reason which must not be overlooked in relation to the casting off of the hoof is the fact that in the neurotomized animal the essential symptoms of the first development of any lesions which might give rise to it, are missing. The first of these symptoms is the pain which is normally manifested by the lameness, and for that reason it is that the care and attention required by the foot of a neurotomized horse are at once so important and so commonly overlooked and omitted. But without ignoring the possibility of this accident, the question is presented, whether it is of such common occurrence that its frequency constitutes a cogent reason for abolishing the operation.

Our answer to this, founded on the showing of the record, must be given in the negative. To quote but one among many authorities—Professor Nocard says that out of more than one thousand operations, he has never met with that accident. For ourselves, in a practice of many years, with a number of neurotomy cases which we can count by the hundreds, we also have never encountered it. In the only case we have seen, other causes existed in the form of suppurative corns, which were overlooked, and which were, moreover, complicated with gangrene of the velvety and podophyllous tissues.

The Softening of the Perforans Tendon and its subsequent rupture, is also a very severe sequelæ of neurotomy. This may take place almost immediately after the operation, or it may be postponed until after a few months, when the animal has resumed

his work. It has, indeed, been charged to undue haste, in compelling the animal to labor without allowing sufficient time for the healing process to be completed, and it is also alleged that it is a consequence of the performance of the operation on both sides of the leg at once. It is both a possible theory and a plausible argument that the failure of the tendon is the result of the shocks inflicted upon it while in a condition of disease and unconsciousness, and this may explain the possibility of the accident without any reference to the circumstance of putting the animal to work. But this falls far short of proving that the neurotomy exercised any potent agency in bringing on the softening and rupture. And as to the effect of performing the double simultaneous operation, our opinion will be readily inferred from the fact which we here state, that out of the large number of neurotomy cases which have passed through our hands, we have seen but a single case of softening and rupture of the perforans tendon, and that was associated with a fracture at the os pedis. The horse had been operated on upon both feet, and on both sides at once, for navicular disease of old standing, and on the third day following he was found in his box standing on both fetlocks. He was destroyed and it was found that the tendons of the perforans had given away in both feet, with a fracture of the navicular bone and os pedis on one foot, and of the os pedis alone at the semi-lunar crest on the other. It is our constant habit to operate on both sides, and with this sole exception, we have never met with softening of the tendons.

Springhalt.—Beugnot and Renner report cases in which the performance of the operation on the hind feet was followed by the appearance of springhalt.

In addition to the points we have been discussing, other alleged objections exist, which may claim superior force and value, but there are none among them of sufficient weight, in view of the many benefits realized from the operation, to justify its repudiation and abandonment.

Among these may be mentioned the theory that the foot deprived of its sensibility by neurotomy is more exposed to the sequelæ of pricks, contused wounds, corns, etc., from the circumstance that there is no betrayal or visible manifestation of the lameness which is usually indicative of lesions of that organ.

It is further objected that in many instances the lameness shows, sooner or later, a tendency to relapse. But there is little

validity in this allegation, from the known fact that in a majority of cases its early recurrence is mainly due to imperfect methods or an unskillful performance of the operation, and cannot, for that reason, be considered a proper incident of the case, but simply an accident, which may be obviated by care and precaution, and in judging the transaction, must be eliminated from the argument.

Probably the most important and most nearly valid objection is that the suppression of the nervous influence has more or less effect upon the nutrition of the digital region. Notwithstanding the observations of Braael, the question of the direct influence of the digital nerves upon the nutrition of that region is a point which has not yet been thoroughly comprehended by our physiologists. For this region this objection, and the points involved in it, call for further study, and it is nearly certain that when it has received this the end will be the removal of the reproach brought against neurotomy of interfering with the vegetative life of the digital region.

Having thus examined the objections which have been urged against neurotomy, a consideration of the advantages claimed for it will come next in order of mention. Leaving out of view the few failures to which the operation, in common with every human act or endeavor, whether in great matters or small, is from the constitution of things, liable, we proceed to the facts which demonstrate the usefulness and value of the treatment, with a description of the various modes of procedure practiced by different surgeons. The facts of the direct and successful results which beyond question have been secured, are so numerous and so patent, and they so far counter-balance all possible accidents, that no conceivable array of abortive cases, if reported truly and without prejudice, can impair their force and significance. It would be impossible to reach even a proximate estimate of the value saved and the loss prevented by the restoration of unnumbered useless and suffering animals to comfort and usefulness.

And these are what might be called the positive or direct advantages of neurotomy. But besides these, there are other advantages in the secondary effects of the operation, of which the importance cannot be ignored, especially when they are commended to our attention by such authority as that of Professor Nocard, of Alfort, when he says: "In several cases I have noticed a great

diminution in the size of exostoses (ringbones), which we treated by neurotomy; . . . " and again, "Neurotomy, by removing the pain existing in the posterior parts of the foot, removes the cause for knuckling, and prevents the retraction of the tendons;" and further, "It prevents also the serious accidents, so frequent after firing of the coronet, sloughing of the skin, cartilaginous quittor, necrosis of tendons or ligaments, opening of joints, etc., all being accidents likely to follow the severe cauterization which, to be successful, is required in the treatment of those exostoses."

Speaking of these advantages, Zundel says: "In rare cases, besides the removal of the lameness, the recovery of the disease which gave rise to it, may also be observed. Thus, after neurotomy, contracted feet have, after a few months, regained their normal form, and exostoses have stopped their growth and even diminished in size."

Having thus considered this matter, both *pro and con*, giving on one side the objections urged against it, with the alleged facts and inferences with which its opponents seek to maintain their argument, and on the other hand, shown the reasons which influence the friends of the operation in advocating and putting it in practice, with their statement of its utility and the important benefits it is capable of conferring, we are prepared to examine into the conditions which indicate or counter-indicate this particular method of surgical interference.

Bouley, speaking of its indications, said: "When the digital region is the seat of a chronic disease, manifested by pain and continued lameness, provided the alterations of structure are not of such a nature as to interfere mechanically with the execution of the function of the region, neurotomy is indicated." And speaking of lameness, the seat of which is not located, Messrs. Hardy and Hugues go farther, for with them "neurotomy can and ought to be performed when a lameness from an unknown cause, and whose nature is not recognized, has for a period of more than three months resisted ordinary therapeutical and surgical means."

Taking these as axiomatic rules, laid down by such authorities, and substantiated by the results obtained by their observance, it becomes evident that in all cases of lameness of the nature described by these writers, or, to repeat, lameness and pain from an unknown cause, neurotomy is the indication, and if it fails to cure

the undiscovered disease, it will, at least, relieve the lameness, if not in all, yet still in a large majority of the cases.

In contraction of the heels, or in feet subject to chronic corns, as result of their conformation, and in some cases of chronic laminitis, where there is either no alteration of structure, or very little, as well as in keraphylocele, here also neurotomy is beneficial. But it is principally in navicular disease that its advantages are best illustrated. And next to these, as best adapted to prove and exemplify its benefits, must be classed ringbones and sidebones, the characteristic exostoses of the digital region.

Excellent results have followed it when performed for the relief of the lameness which often supervenes upon severe injuries, or operations about the foot, such as fractures of the phalanges, crushing of hoof, or any of the sometimes violent acts of surgical interference necessitated by the diseases of that region. The question has even been discussed of the probability of obtaining beneficial results in tetanus, following traumatic lesions of the foot; especially in punctured wounds.

A glance at the counter-indications of neurotomy will furnish a plausible explanation of the objections alleged against it in its earlier history. In the fact that the complications now recognized as thus related to it were then unknown, and consequently unrecognized, and the operation performed notwithstanding, we at once discovered a sufficient reason for the failures and bad results of the treatment, and the consequent odium into which it naturally fell. It was not yet adequately comprehended—it was misapplied—it was, perhaps, unskilfully performed—*it failed.* A very logical formula; but it ought not to have been denounced.

Neurotomy is indicated in navicular disease, and for some in the very incipiency of the attack, all other modes of treatment being only palliative and temporary, and when it has advanced to its chronic stage an operation will be of little advantage, or wholly unsuccessful, if at this period the bone has become extensively diseased, and the tendon reduced to the condition of a mere membraneous pellicle. It is also contra-indicated in all forms of acute inflammation of the foot; in badly formed feet, such as the flat or pumiced of chronic laminitis; and, again, when the lameness originates in a very large exostosis or other bony disease likely to become a mechanical obstruction to the movements of the articulation, or to the play of tendons, or to produce anchylosis. To

resume, it may be said with Bouley, "one must not ask from neurotomy more than it can grant, by applying it to cases where the lameness must necessarily persist, even after the removal of pain in the diseased parts."

One important practical point in the performance of the operation is the determination of the place where it is to be performed. A reference to the anatomical disposition of these plantar nerves will aid us here. In the forelegs both the external and internal plantar nerves form branches about equal in size, running on each side of the leg, with an identical disposition. Each of these nervous branches is situated along the tendon of the perforans

FIG. 462.—Plantar Nerves in Digital Region.

P, plantar nerve; A, original of the digital nerves; B B B, cartilaginous branch; C C C, cutaneous branch; D, digital artery, with the nerve back of it; E E, ramifications of the cartilaginous and cutaneous branch; F F, bulbous branches; G, Transverse branches back of the fetlock joint: V, digital vein.

muscles, then, at a point a little above the fetlock, they ramify and divide into three branches, or digital nerves proper; one principal, posterior or continuation of the main trunk, running toward

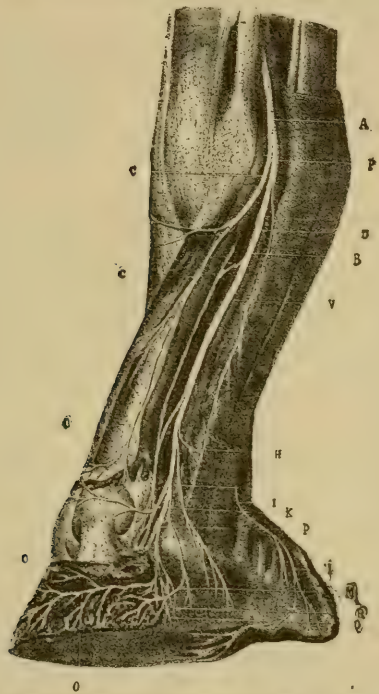


FIG. 463.—Plantar Nerve on the Posterior Face of the Phalanges.

P, plantar nerve; A, origin of the plantar nerve above the sesamoids; B, cartilaginous branch; C, cutaneous branch; D, digital artery; H, branch to the cartilaginous bulbs—sometimes absent; I, branch of the plantar cushion; K, transversal coronary branch; M, podophyllous ramification; O, pre-plantar nerve; Q, branch to the patilobe eminence; R, arterial branches; V, vein which is sometimes found running back of the plantar nerve.

the middle part of the lateral cartilage of the foot, under which it passes; a second, anterior, smaller than the posterior, which is divided toward the middle of the first phalanx, into several branches, ramifying in the tendon and other parts of the anterior region of the foot; and a third, or middle branch, which goes to the coronary band and podophyllous tissue. The consideration of the relation held by these plantar and digital branches to the blood vessels constitutes an important practical point in the operation. Artery, vein and nerve descend on both sides of the fetlock, in such a manner that the vein is situated in front, the artery

in the middle, and the nerve behind—the vein being on a plane somewhat more superficial than the artery, which is a little deeper. Consequently the operation may be performed at any one of four points, and on either side of the leg.

These are, first, above the fetlock, on the plantar nerve proper; second, below the fetlock, on the posterior branch; third, below the fetlock, also on the anterior branch; and fourth, according to Nocard, above the fetlock, on the anterior branch. The first or second of these locations is more often selected for the operation, and forms either the *high* or *low* process.

For each of these operations there is a point of selection. In the high process this is immediately above the fetlock, where the nerve is most superficial and most easily exposed, on the outside border, and a little in front of the perforans tendon. In the low method it is below the fetlock, in the middle of that part of the coronet region where a depression is felt between the tendon and the first phalanx.

The question of preference between the high and low operations has been made the subject of much discussion, and it remains still unsolved. With many the high operation is that which yields the best results; others hold that the object especially contemplated in any given case must determine the point as the occasion presents itself. It is only just to say, however, that the majority of practitioners prefer the high operation; not only because it is easier to perform, but also because it is more likely to be successful.

Personally, we believe that the high operation, with some few exceptional cases, is that which will prove almost generally beneficial.

The instruments necessary are, a pair of scissors, a convex bistoury or scalpel (we prefer the latter), a narrow, straight bistoury, two dissecting forceps, a pair of blunt tenaculums, with an elastic band (Fig. 464), an aneurism tenaculum (Fig. 465), needles, thread and sponges. Those who are familiar with the operation highly commend a new instrument, the neurotome (Fig. 466), which has been invented to take the place of the straight bistoury.

Neurotomy is a simple operation, but a very painful one, and it is necessary, therefore, to have the animal well secured from the commencement of his struggles, which may endanger both himself

FIG. 464.—Blunt Tenaculum, with Elastic Band.

FIG. 465.—Blunt Tenaculum,

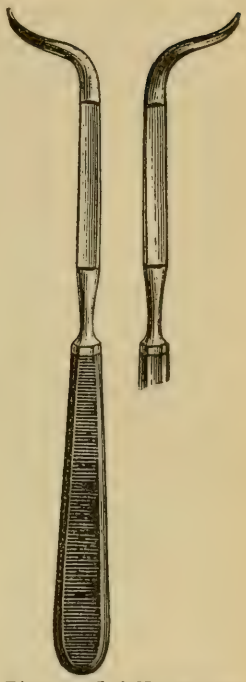


FIG. 466.—Right and Left Neurotomes.

and the surgeon and his attendants. We fully agree with the admitted rule that animals undergoing surgical operations should be thrown and properly secured. We, with other practitioners, however, have succeeded so well in obtaining complete local anesthesia by the use of cocaine, that it has enabled us to perform the operation in the standing position. We, nevertheless, can scarcely see the necessity for general anesthesia when, as we believe, the intense pain which occurs the moment of the division of the nerve can be mitigated by careful local anesthesia after the nerve is exposed, should the operator think it necessary. A careful consideration of the various methods recommended for securing an animal, when cast for operation, has induced us to adopt the following as the simplest, the safest and the easiest to apply and control: The animal is thrown upon the side of the leg which is to be operated upon, and, both legs being bound together above the knee with a few twists of a flat rope in the form of a figure 8, the leg to be treated is removed from the hobble and drawn

forward with a rope attached to the foot. In this manner the inside of the leg is first treated, after which the animal is turned over and the process repeated on the outside. If the operation is to be performed on both legs, the patient may be thrown on either side indifferently, and his legs secured as before described. The under leg is then first released and dealt with on the inside; then rebound to the hobble and the upper leg liberated, and the process repeated on the outside. The horse is then turned over, and the inside of the second leg operated upon is neurotomized and returned to its hobble; and finally, the upper leg, which was on the under side at the beginning, is operated on upon the outside.

Our mode of operating may differ somewhat from those practiced by others, but the general plan is the same.

The patient, having always been prepared by local treatment of his fetlocks, which have been soaked and firmly bandaged for twenty-four hours, is cast and secured, as before stated, the hair is closely clipped with the scissors, and the parts thoroughly washed with an antiseptic solution (bichloride of mercury). Having carefully felt for the location of the nerve, which, in many cases, can be discovered by feeling the pulsations of the artery, an incision is made through the skin with, if possible, one stroke of the convex bistoury, measuring from an inch to an inch and a half in length. It is an advantage to have the incision slightly oblique to the direction of the nerve. Then, with a forceps in one hand, and the handle of a bistoury or scalpel in the other, the cellular tissue is lacerated from the edges of the incision, in order to allow the application of the two blunt rubbered *tenaculums*, which, when in position, hold open the wound; or sometimes threads are used instead, being passed through the edges of the wound and tied on the opposite side of the leg. If the incision has been made in the proper place, after sponging away the trifling hemorrhage which obscures the wound, the nerve may be seen at the bottom, or it may be found surrounded with more or less condensed cellular tissue, and the next move is its dissection. With a dissecting forceps in each hand, we firmly grasp the connective tissue with one, while with the other we tear it away immediately over the nerve, removing it by two or three small portions at a time until the nerve is exposed, lying more or less closely to the artery. Then, with a gentle two-and-fro movement, we isolate the nerve from its attachments with the cellular

structure, and when it is loosened, a fact easily recognized by an apparent shrinking in its length, it is ready for the division. At times we pass under it the blunt aneurism tenaculum, carrying a thread with which to secure it, and when secured, passing the pointed bistoury under it, we divide it with a single upward stroke of the instrument. In other instances, instead of the tenaculum and thread, we use the neurotome, which, having a curved, blunt end, enables us at once to isolate the nerve, and with a simple motion of the sharp edge to divide it from below upward. Upon making the section the lower end of the nerve is secured with forceps, drawn out of the wound, separated from its adhesions by scraping it with the bistoury, and when a portion about an inch or an inch and a half in length has been dissected, and the resection is completed, either with the neurotomy knife or the bistoury, the wound is to be cleansed with antiseptic washes.

The edges are in a very few instances secured by a stitch of suture, but we often prefer a simple antiseptic dressing and a bandage.

There is, of course, no doubt that animals will often struggle during the operation, and especially at the moment when the ligature is tightened upon the nerve, or when the nerve is divided, but the pain in either case is so transient that while we appreciate the value of anesthesia, we cannot recommend, in ordinary practice, general etherization or chloroformization. If it is necessary to have recourse, as some do, to the tourniquet, or of any other means, to control a possible hemorrhage, a large experience in the practice of this operation has failed to show us a single case where such practice would have been of advantage.

The various details of the operation are substantially the same, both for the high and the low process. It must be borne in mind, however, when operating below the fetlock, that the nerve is often concealed by a little fibrous band, which a careless operator might mistake for the nerve itself.

There is probably no special attention required as supplemental to the operation. The wound heals more or less rapidly by first or second intention, and, as a rule, after two or three weeks there are no signs of the occurrence excepting a simple linear cicatrix remaining. Of the accidents which may be encountered during the operation, hemorrhage is the most important. Generally this is referrible to an error on the part of the

operator in dividing the artery or the vein, and usually it is not dangerous, though it may still prove very troublesome. If the artery is divided the ligature must be applied on the truncated ends; if the vein, pressure will be sufficient.

The last important point involved in a case of neurotomy is the length of time required by a neurotomized animal to recuperate before he can safely return to his work. It is undeniable that to a too hasty return of the patient to his accustomed labor most of the objections and alleged complications of the operation may be traced, and for this reason the answer to the question how long a rest shall follow the operation must be *as long as circumstances will permit.*

Zundel, Gourdon, Fleming, and others, make a month the minimum period within which no considerable exertion should be undergone; we would sometimes be still more liberal in allotting the length of the vacation.

CHAPTER XII.

OPERATIONS ON THE GENITO-URINARY APPARATUS.

CATHETERISM OF THE URETHRA.

The object of this operation is the exploration of the interior of the bladder, and consists in the introduction of a catheter, species of canula, or through the urethral canal into that organ, for the purpose of ascertaining and removing its contents. Although the urethra of the male has great length, with an acute curve at the ischial arch, the operation is not a difficult one. It is described as the partial and the complete, according to the distance to which the instrument is inserted into the canal, being partial when the catheter is pushed in the urethra only as far as the pelvic portion of the passage, but complete when it is carried completely into the bladder.

The operation is employed in animals of both sexes, and is indicated in cases of retention of urine, due either to the pressure of calculi, or to the spasmodic contractions of the bladder, which accompany some cases of colic; or, again, when in attacks of paraplegia the animal is unable to micturate naturally. It also constitutes one of the first steps of the operation in urethrotomy, in cystotomy, and in lithotrity.

We shall consider the operations separately as performed in males and in females.

In Males.—The catheter used in veterinary practice for male solipeds is composed of a tube of wire, twisted in close spirals, and covered with a species of thin oil-cloth, making the outer surface perfectly smooth, and forming a perfect canula. It is furnished with a stylet made of flexible rush broom, or whalebone, which can be readily withdrawn from the cavity of the instrument.

Metallic catheters, invented first by Brogniez, and improved on the plan of those used in human medicine, may also be ob-

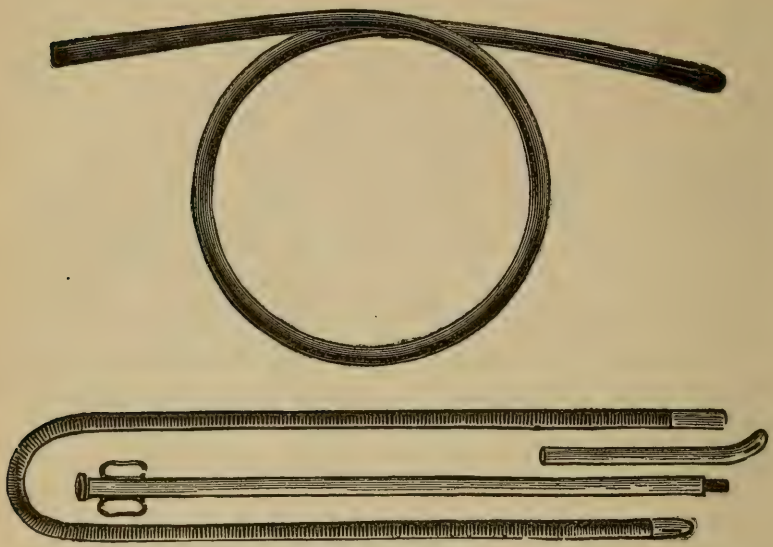


FIG. 467.—Catheter.

tained, but they are not in as general use as the simpler and cheaper kind above described. India-rubber instruments, more or less pliable, constructed on the same general plan, are also made.

In solipeds, urethral catheterism can be performed either when the animal is standing or in the recumbent position. In the first case he is kept quiet by the application of a twitch on one lip and of the hobbles on his hind legs. This done, the first step is to secure control of the penis by drawing it out of the sheath, which must first have been thoroughly cleaned and washed to remove all the sebaceous secretion which by its greasy consistency renders this step of the operation quite a difficult one, many animals resisting the attempt to accomplish this with all their force. But by obtaining and retaining a firm hold of the penis above the glans, and drawing upon it slowly, firmly and steadily, the resistance of the animal may be at length overcome, and the organ brought into full view. The operator then, guided by the little protrusion of the urethral canal, in the middle and a little toward the lower border of the glans, carefully introduces the instrument, which should be freely lubricated with oil or vaseline, pushes it slowly toward the ischial arch. When the instrument

reaches the ischial space the stylet must be withdrawn in order to avoid the difficulty of bending the catheter over the curve formed at that point in the urethra. At this moment a gentle but firm and steady pressure upon the end of the instrument (easily felt at the ischial arch), made by an assistant bending it forward, will, with a little careful pushing, effect its entrance into the bladder. This will, of course, become known at once by the cessation of the resistance, and by the escape of the urine which may be contained in the bladder.

The removal of the instrument is effected by simply drawing it carefully from the passage.

Sometimes simple pressure over the ischial arch is insufficient, and the bending of the instrument into the proper direction is to be made through the rectum, and hence the indication of having that organ well emptied before proceeding to the operation.

The indication of great caution in this operation is suggested by a consideration of the fact that (if the canal should chance to be of unusually narrow diameter or its walls softened by disease) there is sometimes danger of forming false passages, by puncturing the mucous membrane, and forcing the catheter into the erectile tissue which surrounds the urethra. This is an incident which, however, can be avoided by removing the stylet from the canula before its introduction into the urethra, the canula itself being terminated by a perforated oval bulb, perfectly smooth, and thus incapable of inflicting injury.

In Catheterizing Females, a small catheter may be and is sometimes used, but as a rule, the metallic instrument is preferable, the conditions of the method, the shortness of the passage

FIG. 468.—Female Catheter.

and its comparatively large diameter, with the facility with which it can be entered, rendering the metallic on all accounts more eligible than the composition or the rubber tube.

The instrument, being lubricated with oil or vaseline, the operator, opening the vulva with the left hand, introduces his right, holding the instrument, into the vagina, and carries it forward to the meatus urinarius, which he can feel at about six or seven

inches in front of the vulva. While thus holding the instrument, he feels, with the middle finger of his right hand, for the mucous valvular fold which covers the meatus, pushes the finger under it, and then, bringing the bulb end of the catheter to the opening of the urethra, inserts it into the bladder.

The accidents that may arise from carelessness, or otherwise, in the catheterism of males, are not met with when treating females.

URETHROTOMY.

Incisions of the urethral canal are made for various purposes. The removal of foreign bodies, usually calculi; the restoration of the suspended power of micturition when is has been caused by the closure of the passage; the establishment of an artificial urethral opening; and the penetration of the cavity of the bladder when necessary for surgical purposes—these are among the reasons for which this important canal is incised by the surgeon. It is principally performed on males, the dimensions, aside from its shortness, of the urethra in females being, as a rule, ample, and the organ sufficiently dilatable for the removal of calculi, or other objects, without involving the necessity of an operation. Among the males, the ox is the animal which most frequently requires it, by reason of the peculiar liability of this animal to suffer from a constitutional tendency to the formation of calculi and the fact that these accretions are often arrested in the urethra, in consequence of a peculiar double curvature, or S formation, in the penis.

With horses, it is in some districts quite a common operation. In these animals, however, the calculi, though of rare formation, are larger and are more generally retained, either in the bladder or in the first portion of the urethra. In smaller animals, calculi are also quite common and troublesome, especially in dogs, on account of the presence of the bony formation in the structure of the penis.

In the horse, the principal operation is performed in the perineal region, or the part extending on the median line from the anus to the scrotum, bounded above and on each side by the ischial tuberosities, and below by the flat of the thighs.

The skin of the perineum is very fine and thin, and is hairless

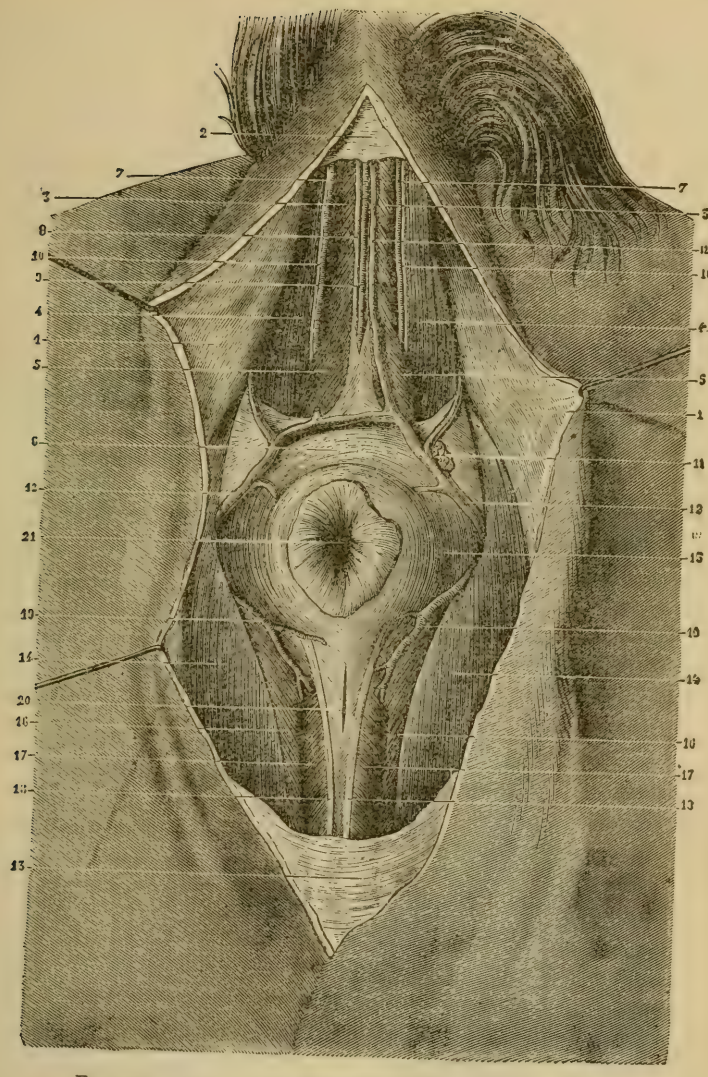


FIG. 469.—Anatomy of the Perineal, Anal and Caudal Regions.

1 1.—The skin. 2.—Portion of the aponeurotic sheath of the coccygeal muscles. 3 3.—Inferior sacro-coccygeal muscles. 4 4.—Lateral sacro-coccygeal muscles. 5 5.—Ischio-coccygeal muscles. 6.—Suspensory ligament of the anus. 7 7.—Lateral caudal arteries. 8.—Deep caudal vein, satellite of the median artery. 9.—Median caudal artery. 10 10.—Inferior caudal nerves. 11.—Lymphatic glands. 12 12.—Superficial caudal veins. 12'.—One of the superficial caudal veins. 13.—Portion of the perineal aponeurosis. 14 14.—Semi-membranosus muscle. 15.—Sphincter ani. 16 16.—Ischio cavernous muscle. 17 17.—Bulbo cavernous muscle. 18 18.—Suspensory ligaments of the penis. 19 19.—Bulbous or internal pubic arteries. 20.—Incision of the urethral canal for urethrotomy. 21.—Anus.

below the anus, but downward and on the sides, is is covered with short hair. Below the skin are found the two principal layers of aponeurotic covering, divided into the superficial and the deep. The former, of fibro-elastic texture, is the continuation of the dartos, and covers the perineal region, thinning down as it nears the anus, to disappear at the sphincter ani. Its most superficial fibres give attachment to a subcutaneous muscular fasiculus, which from the splineter ani runs downward to lose itself about three inches below. The latter plane, or deep aponeurosis is formed of white inextensible fibrous tissues. Intimately adherent by its external face to the superficial layer, it covers and unites with the accelerator urinæ, and the ischio-cavernous muscles, as well as with the suspensor and retractor ligaments of the penis. It then passes between the ischio-cavernous and the semi-membranosus, to attach itself above on the ischial tuberosity and become lost downward on the thighs. Some of its fibres directly surround the fixed portion of penis, and join the aponeurosis common to all the muscles of the flat of the thigh.

The suspensor and retractor of the penis form, in the upper perineal region, that is, from the anus to the ischial arch, an expansion of sufficient width to form a true anatomical layer. Below this they represent bands about half an inch wide, situated on the median line, and covering the accelerator muscle. They are formed of white muscular fibres. The blood-vessels and nerves of this region, with the other parts pertaining to the anatomy of the urethra, have already been considered.

The peculiarity that belongs to the penis of ruminants must not be overlooked, when the question of urethrotomy in these animals is under discussion. Their penis is very long and thin, and is surrounded in the perineal region by a complete aponeurotic sheath, and on a level with the pubis it has two curvatures, which give to the organ the form of an S. On a level with the second curvature it gives attachment to the suspensory ligaments. The free portion of the organ is elongated, strongly filiform, and covered by a fine, rosy mucous membrane. The peculiarities possessed by the penis of the horse do not exist in cattle.

The operation of urethrotomy is classified and designated with reference to the part of the urethra, which is to be divided, and this is of course determined by the location of the body to be removed, making the designations principally regional; and it is

therefore said that the operation can be performed in three ways, though *three places* would be the more accurate phrase.

Thus we have first, the incision at the point of the penis, or *preputial urethrotomy ;* second, the division in the scrotal region, or *scrotal urethrotomy;* and third, the incision below the anus, or *ischial urethrotomy.*

Preputial Urethrotomy.

In horses and dogs the urethra becomes more or less contracted toward the full extremity of the penis, and calculi are therefore apt to become arrested in that locality ; in other cases, masses of sebaceous matter will collect in the navicular fossa. In sheep, saline concretions are found, either in the prepuce or in the urethra. All these conditions involve a contingency of surgical interference. To remove them in the horse and in dogs, a transverse incision is made with a bistoury over the spot where the presence of the foreign body is detected, and it is readily disposed of. If the erratic substance is in the urethra, an incision is made through its membranes and it is removed in entirety, or sometimes after having been reduced to fragments by means of a probe or of a curator. In sheep, the simple amputation is recommended by some. The wound made in these cases heals without trouble.

Scrotal Urethrotomy.

Scrotal urethrotomy ean be performed either on the front or behind the testicles. In cattle it is ordinarily posteriorly that the calculus is lodged, more commonly in the second than in the first curvature, and hence the indication for selecting this place for the operation. Yet there are practitioners who prefer the anterior section, because the penis being more superficial at that place, there is less cellular and adipose tissue to be divided before exposing it.

In either case, the animal is thrown, with the hind leg carried forward and secured as for castration. If the operation is to be performed behind the testicular mass, an incision is made on the median line, measuring about three inches in length, the cellular tissue divided with the knife or the finger and the penis drawn out through the incision. The calculus is extracted through a longitudinal incision. The canal should then be examined with a probe or bougie, to ascertain whether any more offending bodies are present, and if so, they are of course also removed. The

wound may be either closed by sutures, or, preferably, left without interference, to obviate the possible danger of the formation of future scrotal abscesses.

In the pre-scrotal operation, the hair is first clipped short, and an incision made through a transverse fold of the skin, to expose the penis. The concluding steps are the same as those in the former case.

It is, however, always advisable, when the animal is secured, and before dividing the tissues, to insert the hand into the prepuce to draw out the organ. By thus straightening it and removing the S curvature, it is possible, and sometimes occurs, that calculi are displaced and extracted without the necessity of resorting to the knife.

The urinary fistulas which are among the sequelæ of scrotal urethrotomy, are of two or three weeks' duration, seldom continuing longer. Care must be taken to protect the skin from the irritation produced by the dripping of the urine through the wound.

Ischial Urethrotomy.

This is the most common of the three operations, and is applicable to all males.

It is performed without casting, with the animal hobbled on both hind legs and a twitch on his lip. (Fig. 470.) The decubital position is seldom required. The free use of cocaine has enabled us to operate without any means of restraint, not only in horses, but in camels, which are very awkward and uneasy animals at the best, and especially when in the hands and under the knife of the surgeon. The insertion of a catheter has been recommended by many, to serve as a guide to the dissection of the urethra, while others prefer the artificial dilatation of the canal by the injection of water. In some cases, however, neither of these expedients is necessary. The presence of the calculus and the dilatation of the urethra above it, by the confined urine, greatly assists in the location and puncture of the canal.

The incision must be made on the main line, on a level with the ischiatic arch. The structures to be divided are first, the skin, then the subcutaneous cellular tissue, the aponeurotic layers, and the accelator urinæ; which being completed, a straight puncture can be made in the urethra between the two suspensory ligaments. The incision is then extended upward or down-

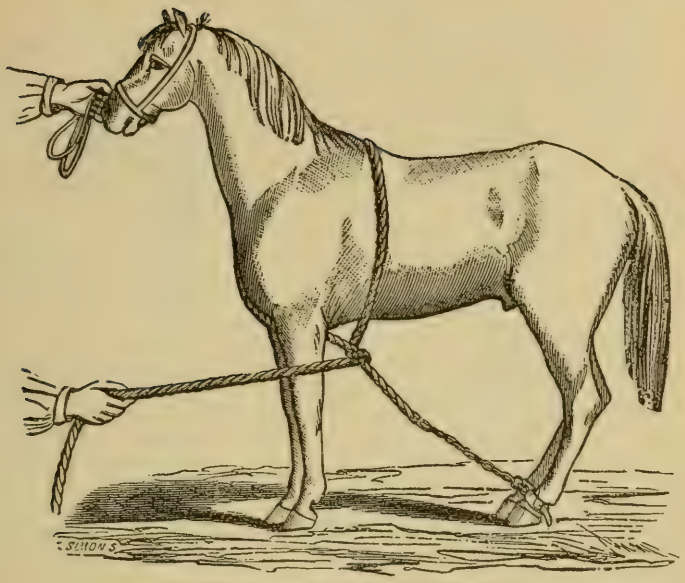


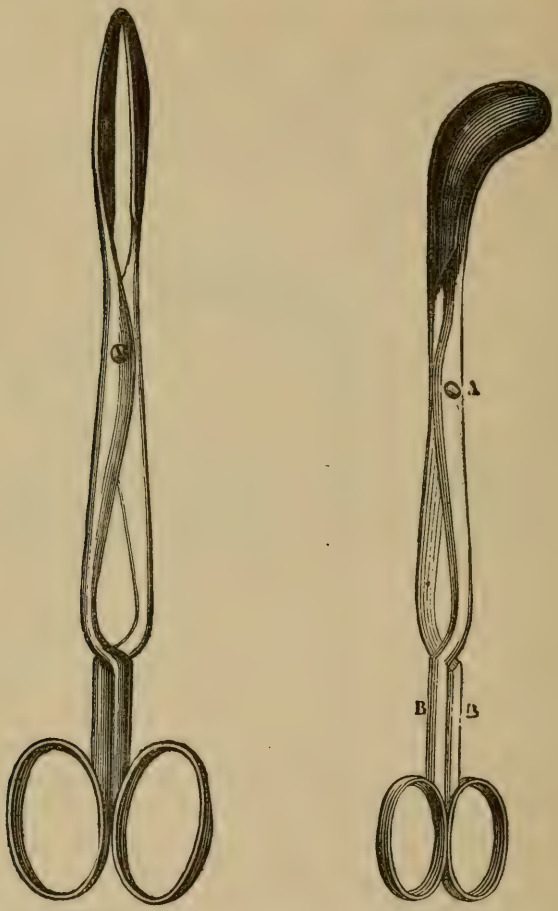
FIG. 470.—Secure for Ischial Urethrotomy.

ward, as may be required, with the bistoury, guided by the grooved director, a blunt bistoury being sometimes chosen from the motive of prudence, in order to avoid possible injury to the surrounding blood vessels.

In our experience we have secured very satisfactory results by adopting the method recommended by Bouley, of making one comprehensive puncture, which penetrates the canal without any preliminary dissection of the incumbent parts, especially when a catheter has been placed in the urethra for the guidance of the knife. The hemorrhage, which generally accompanies this mode of operation is of no great importance, often subsiding of itself, and seldom requiring external hemostatic applications.

We believe it to be the better course, when the object in view has been realized, to leave the wound to itself, without interfering with the healing process by seeking to facilitate it by the application of sutures. It gradually granulates and closes without any special care beyond the observance of cleanliness and the necessary measures to prevent irritation of the skin from the contact of the urine as it "leaks" through the wound.

When the urethra has been opened, in whatever region of the penis the offending foreign body may be lodged, it is readily



Straight. Curved.

FIGS. 471, 472.—Forceps to remove Foreign Bodies from the Bladder.

extracted with straight or curve forceps. These can also be employed to secure those of comparatively small size that may be found in the bladder, and answer very well likewise for those masses of a sedimentary nature that are commonly seen in mares.

There may sometime be some peculiar pathological conditions which render it necessary to prevent the closing of the wound in cases of ischial urethrotomy, and when the formation of a permanent artifical opening should, perhap, be attempted.

The entire closing of the urethra, in its anterior portion, re-

sulting from some special traumatism would be such a case; or again, when the formation of calculi has become an established constitutional habit, and the results of this perversion of the nutritive and assimilative function are always present and continually renewed. In view of this unfortunate state of things, and to prevent the closing of the wound, Troeber recommends the use of a peculiar tube, which, when introduced into the urethra can be permanently retained in place for an indefinite length of time (Fig. 473). We have attempted the formation of an artificial urethral opening, by sewing together the mucous membrane of the canal and the skin, but the results of the experiment were of the most transient character.

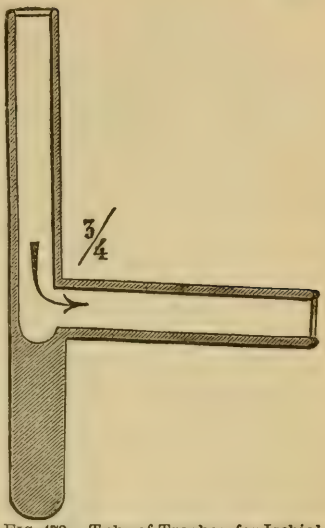


FIG. 473.—Tube of Troeber, for Ischial Urethrotomy in Bovines.

CYSTOTOMY.

Improperly known also as *lithotomy*, is an operation which consists in the incision of the neck of the bladder to remove calculi of dimensions too great for removal intact through the urethra. This operation has no longer a place in our surgery, and, in fact, there is no existing reason for its performance. If a calculus is of small or of medium size the neck of the bladder can always be sufficiently dilated to permit its passage, and if it should be of greater dimensions, and rendered impossible of extraction by its size, the operation of lithotrity is always available, and in experienced hands as nearly certain and safe as can reasonably be expected.

LITHOTRITY.

This term designates the operation of crushing, or piercing, or drilling stones in the bladder, in order to reduce them to fragments, preparatory to their removal by means of forceps or curates, or by washing them out of the bladder with water. It mostly corresponds with, or rather, includes the lithotomy of

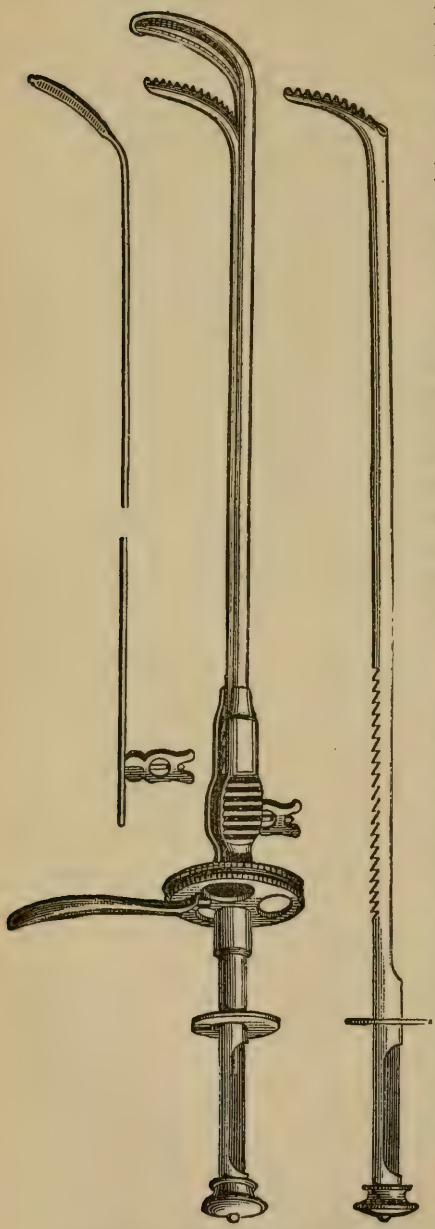


FIG. 474.—Lithotritor of Guillon.

human surgery. It was performed for the first time by H. Bouley in 1858, with the assistance of a practitioner of human surgery, Dr. Guillon.

Horses are more specially the subjects of this operation in cases when the calculi are too bulky and too hard to be broken and removed with the forceps alone. In ruminants, on the contrary, vesical calculi, though more common, and more numerous in single animals, are generally of sufficiently small size to permit the relief of the patient by the simple operation of urethrotomy.

The instruments necessary for this operation are the *lithotritor*, or *lithontriptor*, with also the *crushing forceps*. The lithotritor of Guillon (Fig. 474), or the crushing forceps of Bouley (Fig. 475), are those generally used. We are convinced by our experience of these instruments that the principal, and probably the only objection that applies to them lies against their mechanical construction. We consider them to be too clumsy, too large and too heavy; objections, however, which are very easily obvi-

ated by any competent instrument-maker.

While they must necessarily possess sufficient power to crush the calculi, we fail to see that a proper attention to the features of symmetry, finish, and convenience of manipulation can involve any sacrifice of efficiency. The instrument can be made to possess ample strength, while still more easy to handle when introduced into the bladder through the comparatively small opening of ischial urethrotomy.

A bivalve speculum (Fig. 476) to dilate the wound of the urethra is sometimes of great value. A large syringe, and plenty of water, or what is better, an irrigator for douches to wash out the bladder, will complete the series of necessary instruments. The operation is performed with the animal in the standing position, secured as for urethrotomy, or cast if the operator so prefer it, and placed under the influence of general anesthesia.

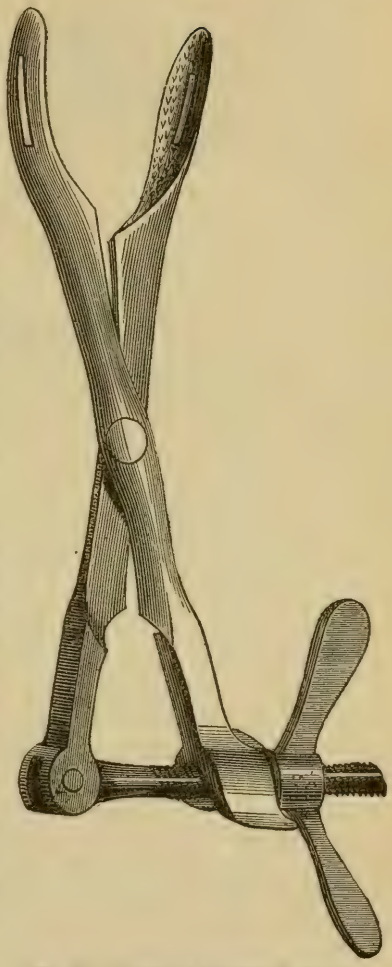


FIG. 475.—Crushing Forceps of Bouley.

We borrow from H. Bouley, the father of the operation, his own description of the *modus operandi:*

Access to the bladder having been obtained by the process already described, the essential operation is divided into three principal steps:

1st. The introduction of the lithotritor, and searching for and grasping the stone; 2d, crushing of the calculus; 3d, removal of the fragments.

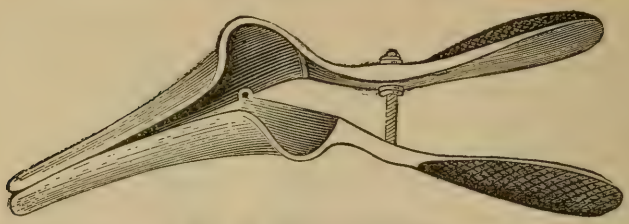


FIG 476.—Bivalve Speculum.

1st. *Introduction of the instrument for searching and grasping the stone.*—This step varies with the instrument, as to whether the lithotritor or the crushing forceps is used. If the first, the instrument, well greased and kept closed, is inserted through the urethral incision, with its concavity resting on the convexity of the ischial arch, and is pushed obliquely forward and downward through the pelvic portion of the urethra and the neck of the bladder. When in this cavity the branches of the instrument are opened, and by a slight and slow movement made to traverse the cystic space until it comes in contact with the calculus, which then drops into the hollow of the branch adopted by its shallow form to receive it. The jaws of the instrument are then brought together and the stone firmly secured.

The same description, in every particular, applies to the manipulation of the crushing forceps.

In some cases, however, it is necessary to disarticulate the instruments, and to introduce the branches separately, uniting them when both have been inserted.

It is important, in every case, to leave a small portion of urine in the bladder to facilitate the movement of the stone and aid in its seizure without grasping and pinching the lining membrane of the organ. If the bladder is empty a portion of water might be injected.

2d. *Crushing of the Stone.*—This is done by slowly approximating the jaws of the instrument. It is not necessary to reduce the stone to very minute particles. It will be sufficient if their dimensions are not too great to permit their free escape through the urethral passage.

In removing the instrument after accomplishing the crushing, a great deal of the comminuted calculus is extracted between its jaws.

3d. *Removal of the Fragments.*—Dilating the urethral wound

with the bivalve speculum, a stream of water is then thrown into the bladder, either with the syringe or the tube of the irrigator. The water ought to be tepid and antiseptic; and a hand introduced into the rectum and manipulating the bladder, will facilitate the repulsion of the larger fragments, and the washing out of the smaller. The general attention required in all cases of serious operations will be necessary after the performance of lithotrity. In respect to any special dressing, they are the same as those indicated in simple urethrotomy.

Serious, however, as this operation is, it is comparatively free from dangerous sequelæ. Hemorrhages of easy control have been met, urinary abscesses, with infiltration, have occurred, serious wounds of the urethra, of the rectum and of the bladder may also happen, but they are of rare occurrence, and can be avoided by careful manipulation through all the steps of the operation.

AMPUTATION OF THE PENIS.

This operation is indicated in the horse when the penis becomes the seat of warty growths; of epithelial, papillomatous, or cancerous degenerations; of fracture; of paraphymosis, or of paralysis. Warty growths are usually found covering more or less the free part of the penis; or its free extremity; or the glans penis; and are also sometimes met with on the inside of the sheath, their presence being accompanied with an offensive and very irritating sebaceous discharge, becoming at times so painful as to interfere with micturition. They resist the severest forms of treatment, and it is not unusual for them to develop into forms of a more alarming nature, notably those of chancroid degeneration, of which, in fact, these epithilial growths are but the seminal origin. In other cases the erectile tissue of the glans penis becomes the seat of ulceration, extending in depth, spreading in such a manner over the penis that the free portion of the organ becomes a mere mass of bleeding surface, of irregular aspect, macerating in the pus which abundantly forms, and which escapes with its peculiarity of bloody saniousity, with the most repulsive odor and irritating effect, rendering the act of micturition most painful and difficult. In many instances the animal so dreads to bring his penis out of the sheath that he urinates within the cavity formed by the folds of the skin, adding another source of irritation to that already

existing. And if the penis is still allowed to pass out of the sheath, the micturition is made with a crooked stream, which instead of escaping forward is, on the contrary, discharged backward. In such a case no treatment will relieve the difficulty but the removal of the entire diseased structure.

In fractures of the penis; in many conditions of paraphymosis; or in those of paralysis, the organ hangs suspended outside of the sheath, and cannot be restored to its cavity. If pushed back it soon returns to its abnormal condition, and even if retained by artificial means, will continue in place only while the means are continued to enforce it, becoming displaced again whenever the restraining agency ceases to operate. This serves to render the animal useless, in consequence of its appearance being so repulsive as to preclude his employment in public view. Of course the only radical cure for such an ailment is the knife or its equivalent.

The operation usually consists in the removal of the free portion of the penis, the necessity for going beyond this seldom occurring, yet in order to reach the diseased part it is sometimes necessary to divide the sheath along the median line.

The general anatomy of the organ, as far as it relates to the operation, is very simple. The penis it formed by the corpus

FIG. 477.—Penis in Normal Condition.

cavernosum, a long, erectile structure, flattened from side to side, and grooved on its inferior border for the reception of the corpus spongiosum urethræ. Terminated inferiorly by a blunt point, this corpus cavernosum dips into the erectile tissue of the urethra. After passing out of the pelvic cavity, by the ischial arch, the spongious portion of this canal, is received into the groove of the corpus cavernosum, at the anterior part, and also extends beyond it. The mucous membrane is covered externally by the tissue

which gives to this part of the urethra its name, and this erectile tissue terminates anteriorly in an enlargement, more or less developed, forming the head of the penis, or the glans penis. The urethra proper protrudes a little below the center of the head of the penis, and shows in a cavity underneath, the urethral fossa, more or less filled with a sebaceous secretion. The blood vessels which ramify in these erectile structures are the two dorsal arteries of the penis, anterior and posterior, and the veins, which form large branches, running also upon the dorsal border of the organ.

Zundel very wisely insists upon two principal conditions (to which we shall again refer) to realize in the operation, *first* to manage to leave a free means of exit for the urine, by cutting away less of the urethra than that of the cavernous body, and *second*, to avoid the hemorrhage, which is especially liable to take place in horses, on account of the abundant circulation in the erectile tissues.

The animal if to be placed in the recumbent position, as in the operation for castration, that is, on the left side; or it may prove advantageous to place him on his back.

Five modes of operation are described by different writers on the subject—1st, the ligature; 2d, cauterization; 3d, excision; 4th, by scraping; and 5th, by crushing.

As an adjunct to the various instruments which these different operations may require, metallic catheters are also necessary.

The Ligature.—The catheter being introduced into the urethra, beyond the point where the amputation is to be made, a strong ligature is applied at that point and tightened sufficiently, if possible, to strangulate the portion of the penis which is to be removed. After from twenty-four to forty-eight hours, the external layers of the tissues will have become mortified, even to a certain depth in the penis, and a new ligature is then applied, and strongly tied like the first one. The deeper layers of the penis are also, after a day or two longer, so mortified that they continue attached to the tissues above the ligature only by a small particle, which can be divided with the knife. The catheter may then be removed or it may be allowed to remain in place a few days longer. No special subsequent treatment is required. If, after a few days, micturation seems to become difficult, the urethral opening may be enlarged by the introduction of a bougie

or a catheter, or again enlarged by an incision with the bistoury. Instead of the ordinary string, an elastic ligature may be substituted with the advantage of maintaining an uninterrupted pressure upon the tissues up to the moment when mortification is established in the part to be amputated.

Cauterization.—No catheter is required with this plan. Two ligatures are applied, one anterior, by which the penis is kept out of its sheath, and one posterior, acting as a hemostatic, placed above the point where the division is to be made. The operator then with a flat and sharp cautery, heated to white heat, makes a complete section of the penis.

But, says Zundel, "as the urethra is especially delicate and sensitive, it is better, in order to avoid its retraction, to separate it from the cavernous body about half an inch in front of the place where the section is made." A hollow bougie of india rubber inserted into the urethra will also prevent its contraction.

Professor Nocard has recommended the use of the galvano-cautery, to obtain an easier division of the tissues, a more perfect hemostatis and to shorten the duration of the operation.

Excision.—After introducing a metallic catheter, a rapid section of the organ is made by a single stroke of the knife. Again, says Zundel, "when the urethra is reached, it must be dissected a little forward, toward the glans penis, and caused to protrude about half an inch beyond the point cauterized."

Scraping of the penis.—This method, which was put in practice in 1829 by Moiroud and Delafond, consists in scraping the penis with a bistoury, in such a way that the remaining portion of the organ forms a cone, with its apex formed by the urethra. A catheter may be introduced into the canal previous to the operation and left in place for awhile; or again, it may, if thought proper, be entirely dispensed with. This mode precludes the danger of hemorrhage.

Crushing.—By operating with the ecraseur, the amputation is perfected without danger of hemorrhage. The chain of the instrument is applied at the point of amputation, and by slow and gradual action, cuts through the tissues until the diseased part drops off. The danger attending this method is that the chain may break during the process, in consequence of the resistance of the cavernous tissue. This accident has certainly been encountered by many practitioners, and we have ourselves witnessed it

in two instances. On one occasion it was found necessary to replace the chain twice, and to complete the amputation with the knife.

Reynal has modified the crushing operation by making the action of the ecraseur slower. He has invented a small instrument (ecraseur) which is left in place for two or three days, being tightened every day, or several times a day, until the mortification is complete, and the diseased penis sloughs off. In this method, a metallic catheter is placed in the urethra; in the other the catheter is not required.

In reflecting upon the various modes of operation we have thus described, and noting especially the two very important, and indeed, essential requirements referred to by Zundel, in respect to the matters of micturition and hemorrhage, we are struck with the fact that in none of those methods are these obvious requirements complied with, or if they are, it is in a manner so faintly implied, and so indefinite and unsatisfactory as to be scarcely intelligible, and certainly to leave no distinct impression on the mind, of the importance of the points referred to.

In every case the danger of possible subsequent interference with micturition is threatened, whether the catheter is used during or after the operation, or even, we fear, if left in the passage "at least two months," as recommended by Peuch and Toussaint. We can remember cases of our own which, with even a longer retention of the catheter, were followed by failure. We have attempted the formation of an artificial urethral opening below the ischial arch, and with no better result.

We are tempted to believe that the hemorrhage is less dangerous than many think, and we believe it could be controlled by ordinary pressure, or by plugging the sheath afterward, or by still other means of hemostasia.

Taking all this into consideration, we cannot but think strange of it, that the process used in human surgery, which we find merely mentioned in some European works, but which we believe has been performed by Gerlach, and which we ourselves adopted more than fifteen years ago, should be practically ignored or rejected by writers as well as practitioners. We have practiced it during the period mentioned without having encountered the slightest complication or troublesome sequelæ.

We refer to it as the *only safe*, and as, therefore, *the best mode*

of operation for the amputation of the penis. It differs from any that have been previously recommended, and is as follows:

The animal being prepared for the operation in the ordinary way, the penis is secured with a ligature at its end and drawn out of the sheath, and another ligature tightly applied on the upper part of the organ. An incision of the skin covering the penis is made entirely around the organ and down to the cavernous body, with the precaution of drawing the skin slightly backward, so that when the amputation is completed, and the skin allowed to return to its position, it will slightly overlap the stump of the penis.

We divide the cavernous body, carefully avoiding injury to the urethra, and when this organ is reached it is dissected from its groove forward into the cavernous body (Figure 477*a*) for a

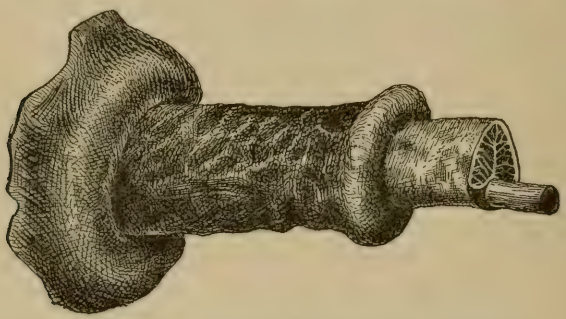


FIG. 477*a*.—Amputated Penis, with the Urethra Protruding.

length extending between one and one-half to two inches, when the division across the urethral canal completes the amputation. The removal of the diseased tissue being thus made, we have before us the stump of the cavernous body, almost dry, the hemorrhage being prevented by the upper ligature, which moreover, secures a good hold and good view of the mutilated organ. The urethra is then slit on its inferior border on the median raphe and both flaps turned upward and brought in contact by interrupted sutures with the skin which has been so divided as to overlap the stump (Fig. 477*b*). These sutures are made close to each other, of strong silk or catgut. The result is that the stump of the penis carries at its lower margin a slit of from one to one and one-half inches in length, which, after allowing for all shrinkage of cicatricial tissue, will always be sufficient to permit thorough micturition.

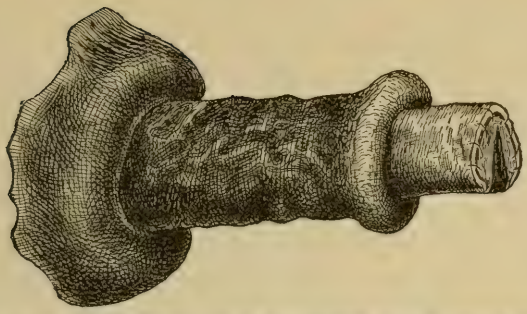


Fig. 477*b*,—Stump of Amputated Penis, with Stitches uniting Urethra and Skin.

The sewing done and the upper ligature removed, the penis retracts within the sheath, and the animal is allowed to rise.

We have been performing this operation for fifteen years, and have never yet met with the slightest complication or disappointment.

In dogs the amputation of the penis is indicated for about the same diseased processes as in the horse. The amputation, however, does not include only the soft tissues, but also the bone of the penis, which is divided with nippers or a saw. The division of the cavernous body is done with the ligature or the ecraseur. Strictures of the urethra are of common occurrence after this operation, and can be overcome only by the repeated introduction of the catheter, or the enlargement of the urethral opening with the knife.

CHAPTER XIII.

OPERATIONS ON THE FOOT.

ANATOMY.

In our domestic animals we call the foot the extremity of the leg, and even only the extremity of the digit, for, considered in a zoölogical point of view, the foot extends from the carpus or tarsus to the last phalanx, inclusive.

The foot of the horse forms an extremely important study on account of the numerous diseases to which that member is subject, and also of the value of the motor powers required from the horse; the old horsemen expressed this importance by the aphorism, "no foot, no horse." This truth finds daily its sad applications in the premature ruin of large numbers of horses rendered useless because of the defects in their feet. All the qualities of a horse are, indeed, considerably diminished and can even be entirely destroyed, by the bad conformation or accidental alterations of these essential organs. The study of the foot of the horse has been the object of many voluminous works, such as those of Girard, Bouley, Bracy, Clark, Anker, Leisering & Hartman, Lafosse, Gourdon, Reynal, Defays, and many others, to which we refer for the more complete description of the organization of the foot.

The organ is composed of two orders of parts, some *internal*, organized and sensitive; the other *external*, formed of a horny, organic substance, the hoof, but entirely void of the property of vital sensitiveness. The internal parts are bones, three in number, the second and third phalanges, and the small sesamoid, which form by their reunion the articulation of the foot; special ligaments, which maintain the connections of these bones; tendons, which fill the triple office of agents of transmission of motion, articular ligaments and organs of support of the weight of the body; a fibro-cartilaginous apparatus, superadded to the third phalanx, and which completes, so to speak, posteriorly, and increases the surface by which it rests on the hoof and transmits

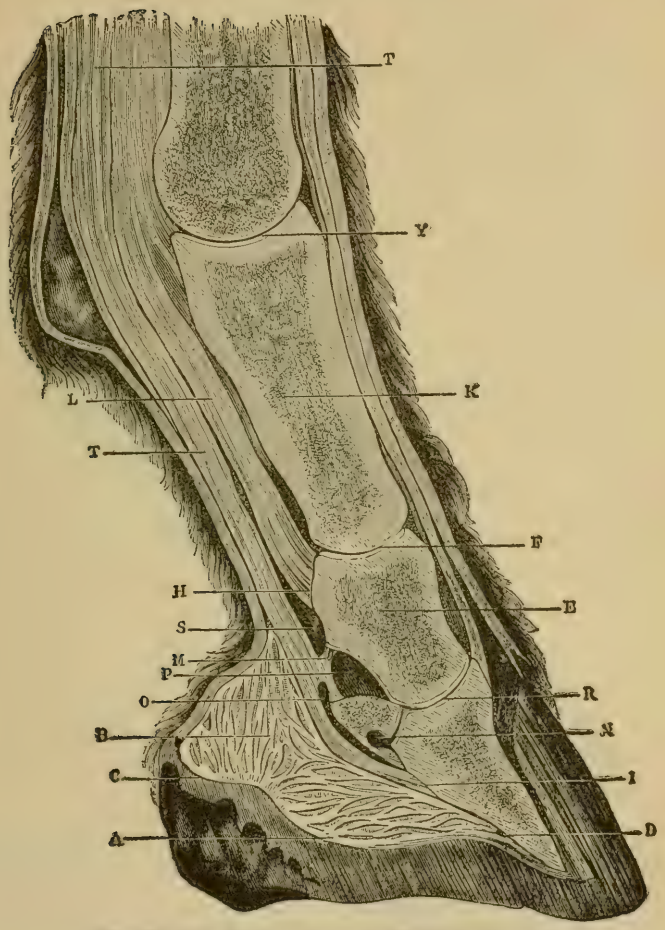


FIG. 478.—Longitudinal Section of the Digital Region.

A.—Lower part of the plantar cushion. B.—Ligamentous bands of the fibrous layers of the plantar cushion. C.—Fibrous membrane of the plantar cushion. D.—Insertion of the plantar cushion to the inferior face of the os pedis. E.—Spongy tissue of os coronæ. F.—Articulation of first and second phalanx. H.—Perforatus tendon attached to the os coronæ. I.—Insertion of plantar aponeurosis to the semi-lunar crest. K.—Spongy structure of os suffraginis. L.—Section of perforatus tendon. M.—Yellow fibrous band uniting the anterior face of the perforans tendon to the posterior face of the os coronæ. N.—Synovial sac of the sesamoido-pedal articular. O.—Tendinous sesamoid sheath. P.—Synovial capsula of the articulation of the foot. T.—Perforans tendon. Y.—Metacarpo-phalangeal joint.

to the ground the pressure which it receives. These are the lateral cartilages and the plantar cushion; arteries, veins, lymphatics and nerves, remarkable for their number, development and disposition; and at last, a ligamentous, sub-horny membrane, or kera-

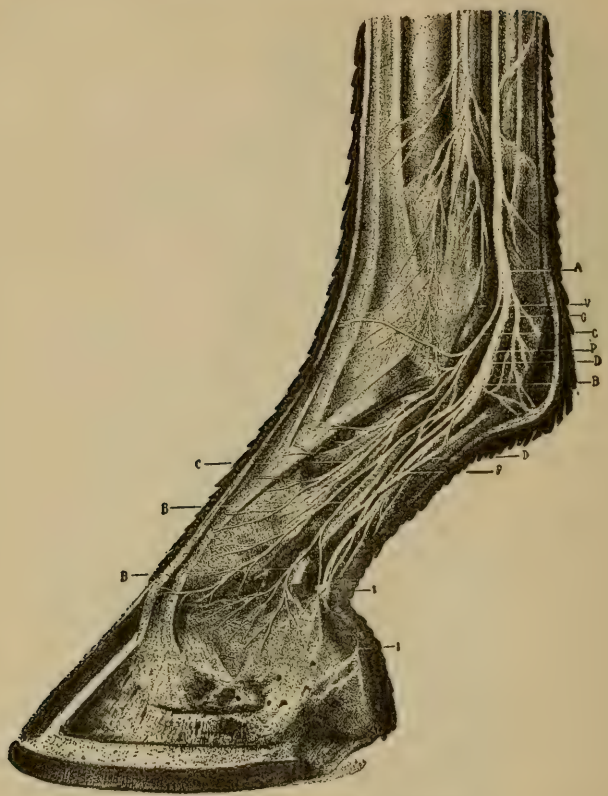


FIG. 479.—Plantar Nerves in Digital Region.

P.—Plantar nerve. A.—Origin of the digital nerves. B B.—Cartilaginous branch. C C.—Cutaneous branch. D —Digital artery. G.—Transverse branches back of the fetlock joint. I.—Nerve of the plantar cushion. L.—Lateral band of the plantar cushion. V.—Digital vein.

togenous apparatus, forming a continuation of the skin, which surrounds the parts of the foot like a stocking, and upon which the foot rests, as a shoe on the human foot. In this apparatus are found: 1st, the coronary band, which forms a rounded projection at the separation of the skin and hoof, and which serves as a matrix to the periople and the wall; at its surface are seen numerous villosities or papillæ; 2d, the podophyllous or laminated tissue which is spread upon the anterior face of the third phalanx, and is remarkable by the sheet of parallel laminæ which it presents at its surface, separated by deep furrows in which are received the analogous laminæ of the internal face of the wall (Figure 481);

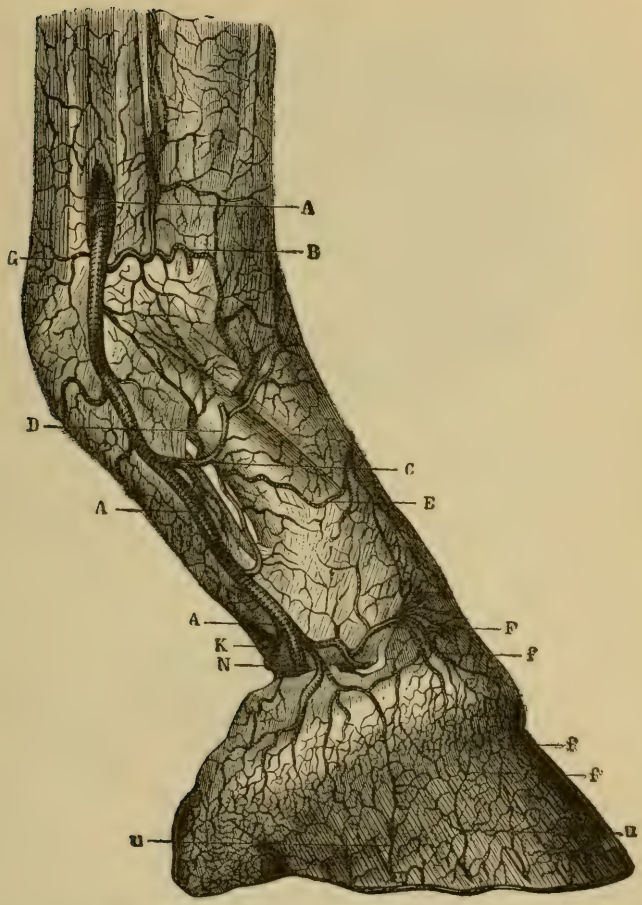


FIG. 480.—Arteries of the Digital Region.

A A A.—Digital artery. B.—Transversal branch in front of fetlock joint C.—Perpendicular artery of Percival. D.—Its ascending branch. E.—The descending branch. F.—Branch to form the superficial coronary circle. G.—Posterior transverse branches. K.—Artery of the plantar cushion. P.—Circumflex artery. C C.—Ascending terminal branches of the digital artery.

3d, the velvety tissue or villous tunic which covers the plantar cushion at the interior face of the foot, and is the secreting organ of the sole and frog, its surface covered with villosities similar to those of the coronary band, and like them, of various sizes, are lodged in the porosities of the internal face of the sole and frog.

The external parts of the foot are four in number: the wall,

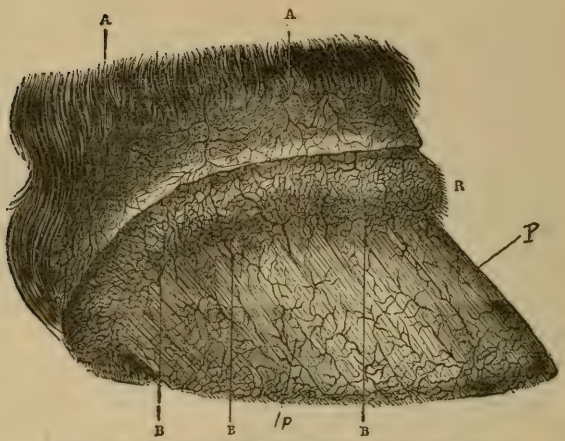


FIG. 481.—Portion of the Keratogenous Apparatus.

A.—The skin. B B.—Coronary band. R.—Its villosities. P.—Podophyllous tissue.

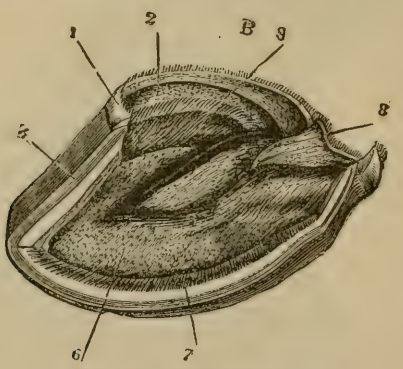


FIG. 482.—Section of the Hoof.

1.—Periople. 2.—Cutigeral cavity. 3.—Keraphillous tissue. 4.—Wall. 5.—Continuation of the periople with the frog. 6.—The sole. 7.—Union of the sole and wall. 8.—Frog stay.

the sole, the frog and the periople (Fig. 482). These form, together, a horny box, the nail, or hoof, which is adapted exactly by its internal cavity to the external contour of the sub-horny membrane, contracting with it an intimate union by a reciprocal reception, and thus completing the structure of the foot, furnishing to the sensitive parts an apparatus, thick, hard, resisting and at the same time elastic, which makes one with them, and protects them against violence from the substances with which the foot, from the nature of its function, must necessarily come in contact.

The horny substance which constitutes the hoof has a fibrous aspect; it is hollowed all over by cylindrical canals, whose superior extremities, widened into a funnel shape, cover the papillæ of the matrix of the hoof, either at the coronary band or velvety tissue, while the inferior open in the wall upon the plantar border, in the sole and frog, at the external or inferior face. These canals are rectilinear, except those of the frog, which are flexuous; their diameter varies from 0, 02 to 0, 2 or 04$^{m.m.}$ These tubes are not only hollowed in the horny substance; they have also proper walls, of very great thickness, formed of numerous concentrical layers, received into each other. These are lamellæ of pavimentous epithelium, which constitute the horny tissue; in the walls of the horny tubes, they are grouped flatwise around their inferior canals, and stratified from within outward, so as to form successive and concentrical layers; in the intertubular horn, these lamellæ are not stratified in a direction parallel to that of the tubes, but at right angles with it. Around the tubes, the lamellæ have an oblique intermediate direction. A granular opaque substance fills up the space lying between the horny tubes and the papillæ.

The hoof, which is a part of the epidermis, develops similarly, that is, by the constant formation of cells in the layer which corresponds to the mucous malpighian body, at the expense of the plasma thrown off by the numerous blood-vessels of the keratogenous membrane. The velvety tissue is the starting point of the elements of the sole and frog; the perioplic band is the organ secreting the periople; and the coronary band proper, the matrix of the wall. Upon these different parts, the epithelial cells multiply and flatten into lamellæ, in the direction of the surface of the keratogenous membrane, as they spread from it. The wall then grows from its superior to the inferior border, and the other parts of the wall from their internal to their external face. The villosities of the coronary band and of the velvety tissue are the organs around which accumulate the epithelial cells; their presence defines, consequently, the tubular structure of the horn.

The laminæ, in the physiological state, do not co-operate in a sensible manner with the formation of the wall; the keraphyllous laminæ form themselves at the coronary band, at the origin of the podophyllous; they descend with the wall, gliding at the surface of the layer of cells which separates them from the laminated tissue, a movement of descent which is facilitated, however, by the

multiplication in the same direction of the said cells. When the podophyllous tissue is inflamed, whether exposed or not, its latent activity soon manifests itself. It gives rise to a great quantity of hard horn, hollowed, as seen by Gourdon, with tubes, and oblique in a direction backward. These tubes, more irregular than those of the normal wall, are disposed in a parallel series; they are in form round, villo-papillæ, which have developed on the face border of the laminæ. In these cases of production of horn by the action of the podophyllous tissue alone, one never sees, between the sensitive laminæ, distinctly formed horny laminæ in the middle of the other cells, as it is observed in the wall proceeding from the coronary band. The horn which rises on the surface of the podophyllous, immediately after the removal of the piece of the wall, is not a permanent one; it must be replaced by the horn of the coronary band. This change is complete, microscopical examination proving that the wall which descends from the coronary band, provided with keraphyllous laminæ, engages itself under the temporary wall, and slides by the action already described over the surface of the soft cells of the laminated tissue. As soon as this tissue, modified by inflammation, is covered over by the permanent wall, its papillæ become atrophied, and its action returns to the limited boundaries of physiological condition.—(*Chauveau.*)

The foot is an organ of support and an apparatus of elasticity; it is through it that the whole animal machine maintains its relations with the ground, and that it adapts itself in its various movements, so to speak, to its roughness. It is this that, as a last spring, distributes and modifies the force of all the movements of the horny mass of the body, whose columns, the legs, may be considered as the resultant. Intermediate with the body and the ground, the foot transmits all the actions of weight reaching it, and also between the body and the sensorium, toward which all sensations resulting from its contact with surrounding external substance return, the foot then becoming at the same time an organ of feeling. To adapt it to this triple formation, nature has given to it three properties, in appearance incompatible with each other, which has, however, harmonized, viz.: first, a very great external hardness, due to its horny envelope; second, a certain amount of flexibility, the combined result of the physical properties of its cortical envelope and of its mechanical disposition of its different

parts, and thirdly, a highly developed sensibility resulting from the high organization of its tegumentary membrane.—*Bouley.*

DISEASES AND DEFECTUOSITIES OF THE FOOT IN SOLIPEDS.

Of all the domestic quadrupeds, the horse is the most exposed to diseases of the foot, which are more or less frequent in him according to the work he is subjected to, the places he lives in, and the nature of the ground upon which he travels. As rare as are those accidents in farm horses, so common are they among horses in cities, of heavy draught, and also army horses; in all, in fact which travel continually on hard, paved and stony roads, and especially in large cities, where all those injuries can but be the result of their constant work on stone pavements, always so rough and slippery. If to these conditions are added the very numerous accidents resulting from bad shoeing, so badly carried on, one will be less surprised to see the foot becoming deformed and altered in different ways, deteriorated, and preserving with difficulty, and for a short time, its state of integrity, and becoming the seat of numerous affections.

We shall distinguish the *diseases proper* and *the vices of conformation* of the foot. The former are generally sufficiently serious to merit special description. Among them some are superficial, as the *false quarters*, *uncomplicated cracks*, or solution of continuity, *thrushes*, *canker;* others of deeper interest, specially those of the keratogenous apparatus, such as *laminitis*, with its complications and sequelæ, *keraphylocele*, *seedy toe*, and *separation* of the wall, which may extend as far as entire sloughing of the hoof; accidents then due to the suppuration accompanying several diseases of the foot. Some maladies are specially the effects of wounds, of contusions such as *overreaching*, *quittor*, *bruised sole*, *bruised heels*, *corns*, *punctured wounds;* others are results of shoeing, *pricked*, *tight shoe*, *burned sole;* others are deep altogether, such as *bionions*, *navicular disease*, and, lastly, *fracture of the os pedis*, or of the *navicular bone.*

VICES OF CONFORMATION.

Among the vices of conformation some are serious, as *contraction of the heels*, *flat foot*, *pumiced foot*, *club foot*, *crooked foot*, *rammy foot*, and, lastly, the *foot with bad horn.*

(a) *Flat foot* (Germ. Platfuss).—By this is understood the foot in which the sole, instead of having the natural concavity, is, on the contrary, flat, and by its whole surface about on a level with the border of the wall and the base of the frog; ordinarily this is accompanied with low heels, more or less contraction, and a well-marked oblique direction of the wall.

Flat foot is generally observed only on front feet, and is very common in lymphatic animals or of low breed, raised in low and damp soils; it may be congenital. Large feet, badly shod or used up by very heavy work, are predisposed to it. It is claimed that the weakening of the sole by too repeated and deep paring of the sole will ultimately bring it on; it is said that abuse of poultices may produce it; it follows excess of the hollowing of the shoe by the upper surface, which, pushing the wall outward, obliges the sole to drop lower than its normal level.

The horse with flat foot rests on all parts of the sole at once; there is no elasticity of the arch of the sole, and percussions take place on it entirely. The actions of the animal are heavy, especially as it is commonly seen when the feet are large. When the foot is somewhat tender, the animal lames easily, especially if the shoeing is bad, or if the animal rests on the sole or is obliged to trot on rough or stony roads, which render the percussion very painful. There arises some irritation, which keeps on increasing, and produces several accidents, such as bruised sole, corns, pumiced feet.

The horse which has flat feet often has weak walls, and as the nails of the shoe become loose, this is often cast.

By shoeing one may remedy this bad condition of the foot. For this, the foot must be pared flatways, the sole spared, the wall relieved only of what is broken off; the frog must be left alone, the heels also; a shoe somewhat wide in the web, protecting, therefore, the sole more than an ordinary shoe does. It will be adjusted so as to rest on the border of the wall only, and not on the sole; still, care will be taken not to hollow it too much or to excess. Sometimes a thick shoe only is necessary, without increased width. Soles of gutta-percha or felt are also used, as we will see when speaking of the pumiced foot.

(b) *Pumiced foot* (Germ. Vollfuss).—Thus is called the foot whose sole projects beyond the level of the wall, and presents a convex surface, extending beyond the plantar border, upon which

the horse rests. It is the exaggeration of the flat foot. In the pumiced foot the wall has a great obliquity, sometimes even assuming a nearly horizontal direction.

The horse is never born with such feet; this is a malformation, accidental, or resulting from various causes. One of the most common is lack of care of the foot, of necessary caution, for instance, in paring, or shoeing in such a way as to bring the rest of the foot on the circumference of the under part in such a way that the sole does not touch the ground, and ceases to be pressed by it. Too much concavity of the shoe may bring on this result, by resting only on a too narrow part of the inferior border of the foot; and by opposition, not enough concavity will compress the tissues, irritate them, and produce the same alteration. Feet become pumiced by laminitis, but this is complicated with seedy toe. Never, then, is the foot pumiced in its whole extent; its deformity stops always at the limit of the inferior border of the bars; beyond them, behind, on each side are seen the excavations of the lateral lacunæ of the frog, so much deeper that heels are higher. The hoof does not preserve its circular shape. It atrophies on the side, and presents at the toe an excess of thickness in the wall; the heels assume a greater development.

This deformity is very serious, and disables the horse easily; rest takes place only upon the sole and frog; after laminitis, upon the sole and heels; it is always very painful. Work upon hard ground and pavement is next to impossible. After laminitis, one sees, during walking, that the foot rests upon the heels, and then by a motion from backward to forward. An animal with pumiced feet has a tendency to forge and interfere; the slightest bruise of the sole gives rise to serious complications. One often observes wounds, suppurations, etc.

The indications are analogous to those of the flat foot; the sole ought to be spared as well as the frog, the walls only ought to be slightly trimmed; the shoe must be made so as to carry the rest upon the border of the wall and protect the sole. When the foot is not pumiced to excess, one must use a broad web shoe, sufficiently concave to allow the sole to rest in it; but it must not be too excessive, as then the base of the rest would not be very firm. A sheet of gutta-percha, or felt, with tar and oakum, may be placed between the shoe and the foot.

(*c*) *Club foot* (Germ. Bockhuf).—This is the foot in which the

wall is straightened more or less perpendicularly, or even obliquely backward, so that the superior border of the wall is more forward than the inferior. The superior levers participate always in this vicious direction, which constantly brings back the rest of the foot toward the anterior part of the wall, and, according to its degree, makes the animal walk more or less on the toe, even sometime obliging him to rest on the anterior face of the hoof; the heels are raised from the ground, and the fetlock, instead of being open forward, seems to be turned backward. This deformity, which exists especially in the hind legs, is very common, and is even natural in mules, and supposes, with its presence, high heels, which throw the rest on the toe, which is always very thick. It may also exist with low heels, especially when due to overwork or other accidental cause. Horses which, like mules, are club-footed only by a peculiar condition of the parts, walk with firmness, and even pull better and work better in hilly countries. If they are unfit for the saddle, it is because their reactions are hard, and that they tire the rider. It is not so with those which are club-footed from hard work; they continually stumble, are subject to knuckling, to interfering, or even to falling; and for these reasons do they always require a mode of shoeing which would give them the missing solidity, and render their walk more steady. This circumstance indicates the necessity of sparing the toe, and throwing the weight back on the heels, which, however, must not be pared off too much. The best shoe for such feet must be short, thin at the heels, with a thick toe, slightly raised upward, and prolonged beyond the level of the border of the wall; small heels to the shoe are often advantageous, as giving an opportunity for rest and relief. The shoe with truncated branches of Lafosse (slipper), which is a short shoe, not extending beyond the quarters, and leaving the heels free, is sometimes used. This shoe is very thick at the toe, and very thin at the heels. It is unnecessary to say that club foot is often cured by tenotomy, or by treatment of the tendinous retraction.

(*d*) *Crooked foot.*—We call by this name the foot whose sides are not of the same height; it may be crooked outward or inward.

This deformity may result from a vice of direction of the regions above; ordinarily, however, only from a deviation of the phalangeal one. Sometimes it is due to bad shoeing, to bad paring of the feet; sometimes it follows unequal wearing of the foot, it being

without shoe. Colts which have never been shod, and are walking for a long time on hard and rough ground, often present this condition.

The horse with crooked feet inward, specially if the deviation is much marked at the toe, is exposed to cut himself with the internal heel of the shoe—to bruise himself; the horse with crooked feet outward cuts himself with the inner toe. Besides these, lameness, from lacerations of articular ligaments, may often follow.

This is relieved, especially in young animals, by lowering the side of the wall which is the highest, and sparing the other; the proper shoe for this condition must be thicker in the branch corresponding to the lower side of the foot. The shoe ought to be changed quite often, in proportion to the existing difference in the height. If the foot is very crooked, it is difficult to straighten it by having a greater thickness of the shoe; it would make this too heavy. Sometimes it is better to use nails with large-sized heads on the lower side of the hoof; and in these cases one might put on *corks* at the heels, external or internal, as required.

(*e*) *Rammy foot.*—This is a defectuosity of the foot, always accidental, in which the surface of the wall offers more or less numerous circles, above each other and running from one quarter or heel to that of the other side. These roughnesses, arrranged in rows, rise always from the coronary band, and form as many elevations gradually descending and disappearing toward the inferior border of the wall. They are so much more serious that they are deep, and sometimes are accompanied with lameness, especially when in great number, close to each other, and when the foot is narrow and long. These circles are sometimes sequelæ of laminitis, and accompany seedy toe; the rings are then in the middle of the toe, which is more or less roughened, like an oyster shell, and they disappear only when the primitive alteration is removed. When they are small, not numerous, and grow down without being replaced by new ones, this favorable disposition of the wall must by stimulated by all the means which may stimulate and keep up the suppleness, by light blisters over the coronet. A light shoeing, often changed, is the best in those cases. Circles which reappear continually are due to an intimate and continued alteration, and are in company with other defectuosities, such as contraction, pumiced foot, etc.

(*f*) *Foot with bad hoof.*—A hoof may be too soft or too dry.

When too *soft*, too greasy, it contains too much dampness and is lacking resistance. Horses which have this weak hoof, as said Lafosse, have the foot tender and unfit for long walks on hard and stony ground; they are, besides, much exposed to lose their shoes, because the hoof breaks up at the nail-holes. This fault is quite common in large feet, frequently seen in Northern lymphatic animals, especially in those which come from marshy districts; if, then, those horses are submitted to stabulation, their hoof becomes dry to excess, which gives rise to narrow and contracted feet. The lower part of the foot must be pared with care, as it has but little thickness; the application of the warm shoe while fitting must be as short as possible. An ordinary thin and light shoe must be used; the nails will be as light and thin as possible, and hammered in carefully.

Too dry hoof is liable to break, because it has lost its physiological suppleness; this brittleness is often met in animals whose feet have been much in water and afterward are placed on dry ground; it seems as if the water had dissolved the adhesion of the horny cells. The same condition follows the excessive use of poultices and also of strong grease in shape of ointments. It is wise to grease, but previously the old crust must be removed. Hoof ointments of wax, turpentine or tar are better. The foot is called *dérobé* (broken) when by the use of a thick nail it is more or less broken at the edges of the wall. These feet lose the shoe easily; animals then go on bare feet, and then it becomes very difficult to put other shoes on. It is necessary in these cases to punch nail holes on the shoe corresponding with parts where the hoof is sound. In paring, all the pieces of broken horn are removed, or at least as much as can safely be done. Nails are secured as high as possible; shoes must be changed as often as possible, and the hoof is to be kept supple by unctuous applications. When the breaks of the horn are too large, softened gutta-percha, or a mixture of gutta-percha three parts, with one of gum ammoniac, melted together, can be used to fill the anfractuosities, all grease having been first removed by a wash with ether; the putty hardens, and the shoe can be tacked on solidly. Nails can even be punched through the gutta-percha.

Instruments.

The surgery of the foot requires special instruments for the operations which influence action upon the hoof, as also for those which are to be performed upon the tissues of the foot proper.

Besides those which are commonly required in ordinary surgery, such as curved scissors, probes, bistouries and forceps, others are needed of special forms and for special purposes; among those most commonly used are the different sage knives and drawing knives.

Sage knives are lanceolated blades secured to handles, and are either double or right or left. The blade, which is curved upon its long axis, may be sharp on both edges, as in the double,

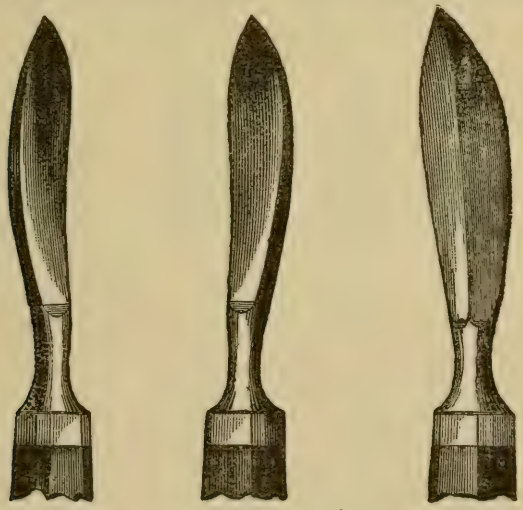


Fig. 485. Fig. 484. Fig. 483.

SAGE KNIVES.

(Fig. 483) or on only one or other edge, when it is known as a right (Fig. 484) or left (Fig. 485) sage knife, being thus adapted to use by either the right or the left hand.

Drawing knives, which are made somewhat like those used by blacksmiths in the ordinary method of paring the foot, yet differ from those in being straighter in their attachment to the handle, and also on being curved on their long axis, being also sharp on both edges. The groove of the instrument is made to vary in

width, and thus can be used as the different steps of the operation may require (Fig. 486). Sometimes the drawing knife resembles more that of the blacksmith, as being sharp on one edge only (Fig. 487), and in this case the groove of the blade is generally much narrower than in the others. Some special operations require peculiar forms of drawing knives; for instance, those which are

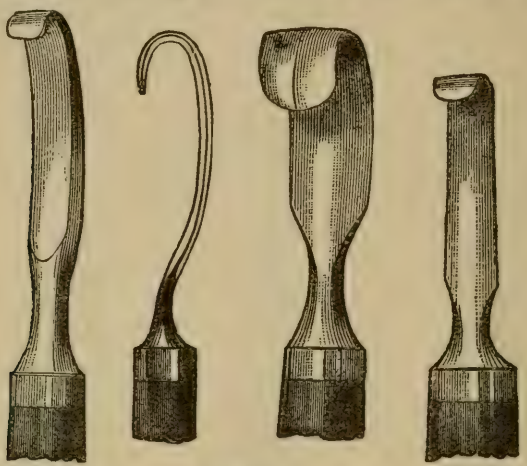


FIG. 487. FIGS. 486. FIG. 488.

DRAWING KNIVES.

made with a blade perfectly straight and narrow, very slightly sharp on the edges, but having a very narrow groove at the extremity (Fig. 488). These are used principally in the scraping of diseased bone-structure, in deep punctured wounds of the foot, and in cartilaginous quittor, when small sections of cartilage are to be removed from the lateral border of the os pedis, which could not othewise be accomplished.

Other instruments are also required, the description of which will be given as we refer to the different diseases where they find their applications.

General Operations.

Removal of the sole (Germ. Absohlen).—This is an operation by which the sole of the foot is removed by severing it from the living tissues underneath. In times gone by this operation was extensively performed, being considered indispensable as soon as the slightest lesion under the sole existed. It was alleged that

unless this was done the suppuration would be likely to spread underneath the horn. In our days it is rarely performed, as it is considered that it presents but little advantage, so far, at least, as it involves the removal of the entire organ. Sometimes, however, portions of it have to be taken off, as in some special diseased condition of the foot, such as in punctured wound, pricking by the blacksmith, burnt sole, etc., the *modus operandi* of which will be considered when treating of these diseases.

Removal of portion of the wall.—A few morbid conditions of some parts of the foot require in their treatment the removal of a portion of the wall, in order that the escape of pus, the removal of diseased tissue, or the sloughing of necrossed cartiliginous or bony structure, as in complicated cases of suppurative corns, of quarter-crack or in cartilaginous quittor. A similar operation is sometimes required in cases of toe-crack, complicated with disease of the os pedis.

These will be further considered when treating of these special subjects.

Dressings.

As nearly every operation of the foot requires a mode of dressing peculiar to the manipulations which have been necessary, we shall, when speaking of the different diseases, where parts of the walls have been removed, include also a description of the peculiar dressing they require.

There is one, however, which is thought much of in veterinary surgery, and of which we will have to say more when speaking of punctured wounds of the foot. This is the dressing with plates, which serve to retain the plantar surface, the balls and pads of oakum, which are placed to protect the wound. The application of these plates is far superior to the leather sole, because of its easy removal when the parts are being examined, and of their easy replacement; thus allowing the surgeon to change the dressing whenever he sees fit, without being obliged to remove the shoe.

DISEASES.

Canker of the Foot.

(Germ., Strahlkrebs, Hufkrebs).—Under this somewhat unscientific,* though accepted name, is designated a peculiar disease

* *Crapaud* of the French.

of the feet of solipeds, seated in the secreting tissues of the horny box, always beginning at the frog, and characterized by alteration of the horny secretion. Names of a more scientific meaning have frequently been proposed, such as *gnawing ulcer* (Bourgelat), *schirrus or cancerous carcinoma of the frog, carcinoma of the reticular tissue of the foot* (Vatel), *darter of the plantar cushion, chronic podoparenchydermitis* (Mercier), and *epithelioma of the frog* (Fuchs). None of these has ever been accepted, and the old hippiatric name has been retained.

History.—It is conceded that the old veterinarians were acquainted with canker, and Vegetius evidently speaks of it, but not until the time of Solleysel do we find a description somewhat complete of the disease and its treatment; Garsault, La Gueriniere, Weyrother and others spoke of it, and have expressed various opinions as to its etiology, and especially as to its treatment. So little progress was discernible in the writings of Bourgelat, Chabert, Huzard and Girard, on that very question, and so many false ideas were admitted, that Chabert in despair has called canker the *opprobrium* of veterinary medicine.

It is but recently that serious research as to the nature of the disease have thrown some light on the question, and established the important fact that its seat is not in the disorganized horn, but in the secreting organs, and that there is an alteration in the products of this secretion; that it is consequently to these that remedies must be applied.

We might refer to the writings of Jeannie, Crepin, Hurtrel d'Arboval, Prevost, Mercier, Plasse, Percivall, Dietrichs, Eichbaum, Wells, H. Bouley, Reynal, Haubner, Fuchs, Rey, Megnin, etc., each of whom has furnished his contingent, while still the intimate nature of the disease remains but imperfectly known, and there is but little certainty either in the treatment or its results.

Let us observe, however, that in our day canker has become comparatively a rare disease, especially in cities, which, doubtless, is because of the cleanliness of the streets. In the beginning of this century, canker and grease—closely related diseases—were frequent in Paris; then horses were obliged to travel through deep gutters of mud, while to-day these affections are exceptional occurrences (H. Bouley). The same thing has been observed by Percival in England. When hygienic precautions were not as well understood as they are to-day, in establishments employ-

ing large numbers of horses, when the stables of mail and stage coaches, and even those of military garrisons, were small, ill-ventilated and dirty, among horses standing in filth and soiled manure, these affections were relatively common; with hygienic improvements, they have almost disappeared. In the army, canker was the cause of considerable annual loss, almost as serious as those from glanders; to-day it is rare and almost unknown.

Improvements in the different breeds of horses, either by better choice of reproducers, or by changes in the mode of feeding, resulting from the progress of agricultural processes, the suppression of common pastures, etc., have contributed to render the disease less common.

Symptoms.—It is seldom that the symptoms of canker can be observed from the start; slow in its progress, and not surexciting the sensibility of the parts, the disease may progress without manifesting any ill effects, and consequently escape notice by the owner or groom, nothing appearing to call his attention to the affected foot. Thus, in a majority of cases canker is only discovered after it has been in existence for a considerable period, and when serious alterations have already taken place. It is often at the shoeing shop, when the shoes are changed, that in the laminæ is observed a moisture more or less abundant, giving rise to softening and raising of the hoof. The disease sometimes attacks only one foot, often several feet at a time; at times when one foot is cured, another becomes affected, and the disease thus appears traveling alternately from one foot to another.

Usually the disease begins with the inflamation of the keratogenous membrane which covers the median lacunæ of the plantar cushion; the hoof covering this is softened, raised by a serous moisture, and once loose, is not renewed, the tissue producing it having lost its function of secreting the horny substance, and now secreting a serous element, which becomes the caseous matter of which we shall speak hereafter.

Sometimes the disease begins by moisture in the hollow of the coronet, by a kind of *grease*, a disease which we shall see to be of the same nature as canker. The is an œdematous swelling, warm, somewhat painful, of the phalangeal region, first serous, then becoming opalescent, which seems to filtrate through the softened, but not yet raised, epidermis. This inflammation, spreading little by little toward the hoof, extends to the plantar keratogenous

membrane, and gives rise to an exhalation of the same nature as that of the skin which produces the separation of the hoof, and the first marks of canker.

Sometimes one may observe at once, a fungoid growth of ficus, formed by an hypertrophy of the tissues underneath; this growth is more or less moist and offensive, bleeding easily, having the aspect of cauliflowers, and protruding through a break of the softened hoof, and forming a thready detritus to be subsequently studied. Commonly, the hoof is more or less loose, and under it is a caseous matter, greasy, ordinarily of a fœtid odor, easily removed by scraping, being non-adherent to the tissue which secretes it. If the parts are well cleaned from this, the velvety tissue of the pyramidal body of the frog, appears to be covered with a smooth membrane of a slight whitish color; the external layer then appears formed by a pellucid epidermic covering, showing through its transparency the purplish color of the capillaries underneath. The velvety tissue is diseased, but still retains its functions, which, on the contrary, are increased but perverted, and instead of secreting a horny substance which adheres to the surface of the keratogenous membrane, produces the caseous matter already referred to. The break in the hoof frequently seems small in size. Nevertheless, the alteration of the keratogenous tissues, viz: the substitution for its normal, of a pathological secretion, whose product is this loose caseous matter, is far advanced. There is then an extensive, though a concealed separation of the hoof. One then must not allow himself to be deceived into supposing it to be a limited diseased process, by the apparent external integrity of the horny box.

The characteristic of canker is its tendency to spread, like cancerous affections. Once manifested in any part of the sub-horny tissues, the special changes which characterize the disease seldom remain circumscribed; on the contrary, they generally extend from that part as a centre, throughout the whole circumference, and little by little, attack slowly but continuously the whole extent of the secreting apparatus, and thus loosen the entire horny box—starting from the median lacunæ, or the glomes of the frog, it extends to the branches and the body of the plantar cushion; then spreads at the side, in the lateral laminæ, from there all round on the velvety tissue, then by degrees reaches the inferior extremity of the podophyllous laminæ and going upward, reaches

the coronary band, the last point, where, in extreme cases, the hoof preserves its adhesions with the tissues which form it. In this condition the disease process progresses more slowly than between the sole and the velvety tissue, and then it seems to remain stationary; otherwise the dropping of the hoof would be possible.

We have seen that often at the beginning, but especially as the disease progresses, there are growths called fici, found principally round the laminæ, the frog and the sole. These are of whitish color, opal, varying in size and in shape; they constitute an irregular mass, formed of those fici pressed together; some of these growths have a wide basis, others are somewhat pedunculated; sometimes they are single, tubercular, slightly elevated; at other times elongated bodies, true fibrous bundles. The fici are nothing more than the normal villosities of the keratogenous tissue which have become tumefied and hypertrophied, and are found principally where, in the normal state, the villosities of the velvety tissue are themselves more numerous and more developed. Where these vegetations are confluent, as upon the sharp edge of the bone, they are separated from each other by a kind of deep sinuous grooves, filled with the caseous matter secreted by the diseased keratogenous structure. These growths bleed easily and grow rapidly again when excised. Those most developed, and which seemed to form a homogeneous mass, constitute, however, an aggregate of smaller vegetations united in a certain part of their extent, and continued at their bases.

Besides the vegetation of the living tissues, the plantar surface of the foot presents, in old cankers, isolated fasciculi of solid horny substance, of thready appearance, soft, analogous in their form to coarse brushes whose hairs are glued together. These isolated, still adherent, brushes are seen spreading toward the sole; they correspond with parts of the velvety tissue which have maintained their soundness in the midst of the diseased surface, and there continue to secrete healthy hoof. These horny growths are ordinarily multiple, and are of various shapes, often twisted, and give to the plantar surface a peculiar aspect, so much so, that their brushy masses sometimes retain the mud of the streets and are filled at their bases with a black and fœtid substance of an ugly appearance.

When canker has arrived at a very advanced period, it is characterized by the deformity of the whole horny box, whose length

and width is considerably increased. The last of these conditions is a sure sign that the disease has spread under the wall of the quarters and of the heels, and has produced the complete separation of the bars from above and below. When percussed, the hoof at the heels gives a dull sound. The excessive length is only an indirect consequence of the disease, and is due to the fact that, so as to keep the animal at work, the walls are spared as much as possible by the blacksmith, so as to avoid the contact of the protruding parts with the ground.

Physiological signs are almost entirely absent in canker. It is a curious fact that the sensibility which is generally highly increased in all affections of the foot, even in chronic diseases, remains always so obscure in canker that animals may be used for a long time without lameness, though the sub-horny tissues have become quite unprotected over a large surface.

Complications.—Very frequently, canker is complicated by a disease of the skin, analogous to it, known as *grease;* a disease which, if not entirely of the same nature, as admitted by Plasse, Megnin, etc., is closely related to it. It is often through this that canker begins, and very often the two diseases exist together in the same animal, one sometimes following the other, just as canker of one foot follows that of another.

Among the complications of canker, as generally admitted, are some injuries of the plantar cushion: inflammation and necrosis of cartileges, ligaments or tendons, and even caries of the os pedis and anchylosis, which are sometimes observed; however, a close examination of the facts allows us to say that these accidents do not arise under the simple influence of the disease alone, but that they are due to the improper use of sharp instruments, of the actual cautery, and especially of potential caustics. As La Gueriniere said, the deep lesions of tendons and of the os pedis, which are observed in severe cankers, have no other cause than the action of too powerful dessicatives.

Duration, march, termination.—Canker is an essentially chronic disease, and may be of long continuance, even lasting for years. Still, under this heading there are many variations, whose cause it is difficult to find. There are horses whose disorganization of the hoof is complete after two or three months. There are others where the disease remains stationary for more than a year. We have seen it remaining limited to one lacuna for months, and all

at once assume a rapid evolution of disorganization. We have noticed this principally after the use of sharp instruments.

Generally, animals affected with canker feed well, and for a long time retain a good condition; toward the end, however, they lose flesh and exhibit symptoms of septicohemia, especially if affected with grease. We do not admit that, as advanced by some, canker can give rise to such virulent diseases as glanders and farcy.

Diagnosis.—At the beginning, canker may be confounded with thrushes, and many veterinarians have considered this as the first stage of canker. There is, however, a great difference between the two: first, as to the anatomo-pathological point of view, inasmuch as the pultaceous, fœtid secretion is less abundant; that the loosening of the hoof is less, and that there are no fici; and again, especially in the point of view of the treatment, where single cases of cleansing, with or without dessicatives, easily control it, while canker remains rebellious to them.

Prognosis.—The prognosis varies. Where the animal is young, well fed, and the disease is not too old, it is favorable. Yet it remains uncertain, as often the most benign form may last long and remain rebellious to all treatment. The severity and the extent of the internal lesions cannot be estimated by the alterations or deformities of the hoof, as these appearances are often deceptive. Canker, though considered incurable for a long time, is not absolutely so—far from it; with rational treatment, properly carried on, it is curable in the majority of cases. There are cases, however, not very rare, where relapses and useless attempts have discouraged the owner as well as the veterinarian, and where it has been more advantageous to destroy the animal rather than to submit him to a long, tiresome, and always expensive treatment.

Pathological Anatomy and Nature of the Disease.—It has always been considered that a morbid condition susceptible of producing disorders so severe as those produced by canker, must necessarily be a deep affection, essential and important to the organic structure, and depending on a complete transformation in its texture. And, indeed, it is the impression which predominated from the time of Solleysel down to the foundation of veterinary schools and which still exists with Girard, who considers canker as a gnawing ulcer which changes and alters the tissues it invades,

and even with Vatel and Hurtrel d'Arboval, who looks upon canker as the carcinoma of the reticular structure of the foot.

It is but recently that these ideas have been abandoned. Dupuy, in 1827, considered canker as a hypertrophy of the fibres of the hoof, admitting at the same time the disintegrations and softening of those same fibres occasioned by an ammoniacal saponization produced by an altered secretion.

In 1841, Mercier expressed the opinion that canker is nothing more than a chronic inflammation of the reticular tissue of the foot, characterized by diseased secretions of this apparatus.

It is now known that there is in canker no essential alterations of the sub-horny tissues; no radical change of their substance, and no deposit of heteromorphous molecules in their structure. This last mentioned fact was well observed by Robin, who in his microscopical remarks constantly observed the absence of the characterizing elements of canker. Hertwig and Haubner, who have made researches in the same direction, arrived at the same result and have noticed the absence of any cancerous cells in canker. This opinion is, however, doubted by Glisberg and Fuchs, who look upon canker as an epithelioma, though they bring no sufficient evidence to establish it.

Except vegetal parasitism, of which we will speak hereafter, and which makes of canker a true dartre, an herpetic disease, as demonstrated by Megnin, there is only in canker a chronic inflammatory condition of the sub-horny tissues which is manifested by a perversion in their secretion, and is complicated by a morbid hypertrophy of the villous processes by which their surface is normally covered. Robin has seen in the fici, papillæ made thicker and more brittle by the plastic infiltration which moistens them; he has observed besides, that at the points where the secretion is good, it is so active, that instead of drying in sheaths, to scale off afterward in transverse pieces, as normally occurs in the frog and sole, the epithelial cells grow lengthwise, as those which form the walls of the foot. Hence these long, horned, twisted threads (epithelioma?) which are seen rising from the sole of long affected cankerous feet.

It has sometimes been admitted that fici had deep roots in the tissues, and even in the plantar aponeurosis, which is an error; injections and macerations having shown that there are no essential changes in the anatomical structures of these parts, and that

what have been considered as the roots of fici were only cellular tissues, which has become indurated under chronic inflammation (Bouley). Fici are only fasciculi of villosities whose vascular network is no longer retained by the thick horny box which encloses them and which is infiltrated with plastic material.

Bouley has already admitted that canker could not be better classified than among skin diseases, with and after dartroid affections, and thus gave reason to Huzard senior; Plass also found that canker had the greatest analogy with grease, and that in it the nutrition of the horn underwent the same alteration with nutrition of hairs in the second affection.

Megnin, in 1864, observed, in operating upon fresh pieces taken from the living animal, and from one which had not received any treatment, that in canker there is constantly a cryptogam, as in favus, and that canker is a parasitic affection.

Examining the caseous product of the abnormal secretion which characterizes canker, Megnin found in it a large quantity of very animated vibrios, swimming in a liquid having in suspension numerous epidermic cells more or less advanced in dissolution; he found besides rounded corpuscles, which he recognized as the spores of the cryptogam, and from which the vibrios escaped at the maturity of the granulations there contained. In examining the fici, he has recognized them to be an aggregate of hypertrophied villosites, at the base of which were found in the mass obtained by a slight scraping epidermic cells or parts of cells enclosed in a net-work of inter-crossed, ramified threads, appearing to rise from certain centers marked by an agglomeration of spores, forming in their whole a yellow spot. In the water of the microscopic preparations, one finds also several of these isolated threads, epithelial cells, globules of lymph, of blood and finally spores; very rarely vibrios; oftener micrococci. These threads are nothing more than the parasites, the mycelium product of the vegetation of the spores; those contained in the serosity, swell, break up, and the granulations which escape from them become for some time the vibrios, or as we prefer to call them, pseudo-vibrios; as soon as the brownian motion, which for some time animates the granulations, ceases, the cells which have proceeded from them (the micrococci) gather together in chains and form the characteristic threads of the mycelium.

This parasite of canker has been named by Megnin the *kera-*

phyton or parasitic plant of the horn, by analogy with the trichophyton, the parasite of the hair. We consider this name very appropriate and prefer it to the name of *odium batracosis*, parasite of the canker, which Mr. Megnin has also proposed.

Etiology.—The causes of canker are yet but little known; there is one, however, which cannot be ignored, and which, if it does not produce the disease, assists materially in its development and is indispensable to its existence. We refer to the condition of dampness. It is that influence of dampness which explains why the disease is so very common in the marshy lands of Poitou; in the pastures of Holland, and in general in low grounds; and why it is more frequent in northern than in southern countries. Canker is incomparably more frequent in rainy seasons than in those where dryness predominates. We have already seen in the history of the disease that it is since the streets and the stables of administration are kept more free from dampness that canker has become less common.

Sometimes the action of direct irritating causes has been admitted, and then the canker has been attributed to irritating muds and the excrementitial liquids of stables; their contact often giving rise upon the skin, upon the glomes of the frog, to an erythematous inflammation, soon followed by a serous flow, which extends to the sub-horny structures and gives rise to an exudation in the laminæ of the frog. This cause produces the rotten frog (thrushes) but not canker. We believe that this cause has principally been admitted by veterinarians who look upon thrushes as the first stages of canker, but this is not so, and for canker to develop itself under similar conditions, others are necessary, which are as yet unknown.

Canker has also been attributed to narrow and contracted feet, so common in horses of meridional climates, and in which the sole is very concave, with the frog and pyramidal body shrunk in. Often in the laminæ of these feet a sero-purulent moisture is discovered, more or less offensive, which is a rotten frog, but not canker, and but seldom followed by it.

To produce canker a simple irritation of the sub-horny structure is not sufficient. There must be a special cause, proper to canker, stimulating alone the characteristic changes of the cause. This cause we find in the cryptogam which characterizes canker, propagates it, and which has no power of spontaneous existence.

As with other parasitic diseases, canker is communicable by contagion; although the examples are quite rare they cannot be doubted. Hutrel, d'Arboval, Plass, Blind and Megnin have observed them, and in all the cases dampness has contributed to the propogation of the cryptogam.

The lymphatic constitution in an animal is eminently propitious to the development of canker, as it is observed to be, in fact, for all parasitic diseases.

It is known by daily observation of facts that horses whose skin is thick, with the hairy system well developed, the feet flat, with thick frogs, are more often affected with canker than animals of a nervous constitution. It is more particularly observed in horses with much white at their extremities, with stockings and white feet, and in those where there is a tendency to albinism.

An unknown diathesis has also been considered as causing a predisposing constitutional organic condition, but this has not been justified by observation. It may happen that canker cured or dried on one foot, may attack another foot, perhaps a third, and then a fourth, to re-appear in the first; this character of the disease has often been mentioned as proof of this diathesic condition; but it may also be explained by its contagious character. The disease remains too much localized to be constitutional, as generally in diathesic diseases we have critical eruptions upon different organs or different tissues.

Treatment.—From the preceding remarks, it is evident that in feet affected with canker, the keratogenous apparatus of the foot has undergone no essential alteration in its structure, that its thickness and density have only increased by consequence of the infiltration and organization in its net-work of the plastic products of inflammation. And, again, the secreting function of this apparatus, far from being arrested, is on the contrary, more active; but the products it gives instead of being concrescible, remain diffluent; hence the impossibility for the hoof to be restored in the regions where this alteration of secretion exists and remains. These important facts, says M. Bouley, must take the lead in the chapter of the therapeutics of canker, because they teach the practitioner that the object to effect, in the treatment of this disease, is not to radically destroy the diseased tissues, as has been too often done and recommended, but to return to them their physical and physiological properties by the application on their

surface, of modifying agents which influence the nutritive and secreting functions of their tissues without interfering with their structure. To reach this point, the most varied pharmaceutical agents have been recommended, the most successful being those which at the same time had parasiticide properties. We, however, find it difficult to give the preference to any of them; and we have now more faith in the *modus faciendi*, to the skill of the operator, to the continued use of dressings properly applied, than to such or such agent; all of those which have been recommended if methodically applied, can cure canker, and it will be wise to employ them alternatively; when one fails at first it is prudent to try another; canker is a disease so often rebellious to treatment, especially when confined to the lacunæ of the frog, that too many remedies cannot be used.

The first indication is to remove the excess of the horn of the wall, the length of which, we have said, is often very great; then prepare a convenient shoe for the dressings. This shoe necessarily varies, as canker is exclusively localized to the plantar surface of the foot or extends to the podophyllous laminæ. Generally an ordinary shoe is used, more or less covered (wide) and so hollowed as to allow the free application of plates by which the dressing is kept in place. When the condition of the disease requires the removal of large pieces of horn, a truncated slipper is used, proportioned in cutting to the extent of the parts of the wall upon which it is to be applied. There are circumstances even when shoes cannot be used, so much does the disease extend under the wall. It is then necessary to use a shoe without nails, or boots, secured to the coronet by means of straps. In all cases the rule is to take care that the dressings remain fixed in the most exact manner, and that through them a methodic, steady, but not excessive pressure is constantly applied over the diseased parts.

The first step of the operation passed, the next consists in the removal with proper instruments of all the loose portions of the horn, either at the plantar surface, at the quarter, or at the heels. One must avoid, in this operation, the excision of soft parts; but the important indication is to follow the disease wherever it exists, and to leave no part of the horn which may have been detached by morbid exudations. Better cut the healthy structures, and have them bleed, than to neglect to completely expose a diseased part. This done, the horn is to be thinned as

much as possible, upon the circumference of the diseased spots, in order to give a suppleness which would ease the swelling of the uncovered parts.

Upon the exposure of the disease where it exists, the fici existing on the surface and edges of the velvety tissues are to be removed with the scissors or sharp sage knife; at the same time the parts of horn which may have remained are to be cut off, avoiding, however, the healthy tissue beneath, which still retains its normal character.

When the canker is very extensive, so that the wall is loose on each quarter, or on all its circumference, it is of advantage to proceed in the required operations at different times.

This done, the shoe can be put on; after which the diseased surface and surrounding horn are to be covered with a thick layer of the medicamentous preparation. If this is in form of a paste, as is often the case, it is spread over with a spatula. If in powder, it is thrown over it carefully. If liquid, balls of oakum are soaked with it and placed on, the whole being then kept in place by pads and plates. The important point is that the dressing should be so applied as to be easily changed, that an exact, regular and sufficiently strong pressure be kept on. No better means can be used for this than the divided plates already referred to.

In canker the dressing must be renewed every day, and even twice daily at the beginning of the treatment. This is an essential condition of success, whatever may be the therapeutical agent employed; and this is not a simple difficulty in practice where the patient is not always of easy access. Moreover, this dressing is somewhat complicated, and can only be skillfully made by the veterinarian himself.

It often occurs that upon the removal of the first dressing, (the second day) one finds the tissues already covered by a layer of hardened horn, adherent to the surfaces. One must then, with the finger, a spatula, or a dry pad of oakum, rub it off where it is found loose and movable and, if necessary, renew the application of the dressing. The same must be done at the other dressings, carefully watching if this new horn thus formed by the influence of the medication, is not separable from the parts underneath by the different morbid secretions of the disease. One must then carefully scrape off all that is not adherent, and thin the edges, and the projections of all the horn which retains its soundness;

the caseous substance being also removed; the same compressive dressing to be put on again.

The modification in the horny secretion, and the formation of a layer of hardened and adherent horn, are especially great in the parts where podophyllous and velvety tissues exist; but are very slow, and surrounded with difficulties in the median and lateral lacunæ of the frog. After ten days of treatment, one may have brought about a normal secretion on the whole circumference of the sole, on the inferior face of the os pedis, and on the prominent parts of the pyramidal body. But in the lacunæ the alteration remains isolated, and resists treatment; and it often happens that, if neglected, it may again spread and the disease reach its former extent. It is then the case, when the disease is limited to the lacunæ, to add to the ingredient already in use and which is kept applied upon the restored parts, another stronger and more active agent, sometimes simply absorbent; here again it becomes difficult for us to advise the practitioner, the number of recommended drugs being very large and the result depending less on their nature than in the intelligent and persisting manner with which it is applied. When caustics are used, it must be done with great care, to limit their action only to the thickness of the keratogenous tissue, and not to carry it to the destruction of the bone, or still worse, of the plantar aponeurosis.

Let us glance at the drugs which have proved most successful in the treatment of canker: First we have the different pyrogenous preparations, especially wood tar, recommended by Bracy, Clark, Reynal and Bouley, and which give astonishing results. Gas tar, oil of cade, petroleum and soot have also been used, but with less advantage; creosote and phenic acid have often shown themselves very useful, by penetrating easier to the base of the villosities where the parasite resides and thus acting more regularly; phenic acid proved very useful with Krause, Gerlach and Zundel.

After these the best recommended preparations are the salts of iron. Hertwig seems to be well pleased with the powder of sulphate, and Arnold recommends the pyrolignite of the same metal; Megnin advises specially the perchloride, which, like phenic acid, is rather a powerful astringent than a true caustic. The preparations of copper have also had their time, and especially the acetates, such as the œgyptiacum ointment (Girard, Schaack, Rainard and Rey); the baths of sulphate of copper were employed by

Verrier, Jr., of Rouen; a solution of sulphate of copper and of zinc in water or vinegar were recommended by Delaval and Haubner; Solleysel employed the preparations of copper, but added to them arsenic and other drugs; Eichbaum preferred the powder of chloride of lime, and Rauch ordinary lime, while Aubry employed a mixture of lime and caustic potash.

Caustics were well recommended by other practitioners, but their prescriptions seem to be contrary to the rule we have laid down in the beginning. However, one must not forget that the tissues of the foot, especially when diseased, offer an extraordinary resistance to the action of caustics; they are, so to speak, impenetrable, and the irritation they produce remains superficial, while where those tissues are healthy such agents produce a deep cauterization. Again, this resisting force of the indurated tissues against the actions of caustics is limited, and it is possible that one, two or three applications may apparently remain inefficacious, where a fourth or a fifth will give rise to extensive cauterization. The result is explained by the repeated irritating influence of the caustic agent, which, by gradually increasing the vascularity of the parts it touches, increases also the means of their absorption and imbibition. These facts must also be present to the practitioners mind, and it is by them that he will be guided in their use, rendering them at will, simply modifying, catheretic, or deep caustics.

Nitric acid was used by Percivall and Delorme, the latter considering it the best means in use. Sulphuric acid has also been employed, seldom alone, but mixed with agents likely to reduce its effects and render its applications more convenient. Collignon and Renault recommend its reduction with alcohol; Mercier mixed it with four parts of oil of turpentine; Prangé with equal parts of tar, and Plass made a paste of it with burnt alum. This last remedy, very simple in its formula, was applied without any dressing; it has proved most excellent in a great number of cases, but may give rise to too deep cauterization (Bouley, Mendel).

Arsenious acid was much used by old horsemen, combined with œgyptiacum, turpentine and other ingredients. Hoffmann prefers the arsenite of soda in solution; he sold his secret to the Austrian government for a high price. Butter of antimony was recommended by Huzard Sr., Prevost, and especially Huzard; chloride of zinc was preferred at the Lyons school.

The treatment of canker by actual cauterization was indicated

by Solleysel, but soon abandoned by him. In applying the cautery upon the uncovered tissues of the hoof, we encounter the chance of producing a very severe inflammation, which spreads by degrees and gives rise to extensive slough of the hoof, as a consequence of the serious exudation which takes place; the action of the cautery may then become either too mild or too vigorous. Still, it has been recommended by Prevost, of Geneva. Hurtrel d'Arboval, who also employed it, used it in the following manner: the parts being covered with a mixture of gunpowder and sulphur, a red-hot iron was applied to the spot, the powder burning suddenly and the sulphur slowly. If the combustion was too slow, he increased it and kept it up by the same means. When the operation is concluded the parts are transformed into a black scar, which can be easily removed by scraping, and the application and cauterization may be repeated, and so on until it appears that a sufficient amount of heat has penetrated the tissues to destroy the material by which canker may be regenerated. The cauterization being once properly effected, then in order to sustain irritation, the foot is covered with Burgundy pitch, or resin, melted and warm, which is allowed to cool off on the foot, when a dressing of oakum and the shoe are put on. The dressing is changed as soon as suppuration shows itself and renewed with the same ingredients in the same manner until the wound becomes healthy and granulating.

It is only for the sake of the record that we refer to the exclusively surgical treatment, based upon the erroneous idea that the fici of canker are abnormal products, deeply implanted in the tissues beneath, and where it was advised to look for the imaginary roots of these fici at their extreme limits. In this treatment, not only the diseased horn was removed, but the entire sole, the plantar cushion and often the plantar aponeurosis was excised. This practice, advised by Lafosse junior, was also recommended in the veterinary schools by Chabert in France, and Dieterichs in Germany. It prevailed for a long time, though experience showed that the wound resulting from such an operation was of very slow recovery, that the frog especially could not be regenerated, that there remained a central ulcer, and that it gave rise to such a malformation of the foot that the animal remained lame for a long time, sometimes for life. Notwithstanding these objections, observed by Jeaune, Girard and Eichbaum, this treatment is still

followed by a few who prefer it to the simple operations of Solleysel, which consists in the division of the loose pieces of horn and the excision of the fungoid projections.

We have thus far only spoken of the local, without referring to the internal or constitutional treatment of canker, recommended by those who look upon the disease as constitutional. Without believing that it can have any real curative effect, we, however, admit its usefulness, when the disease is of old standing, and that the animal has suffered much by it. Ferruginous preparations are specially advisable, and we prefer the carbonates that are used by Delwart to the sulphates recommended by Prevost, Delaval and Hertwig, and it is well to unite them with bitters and tonic powders. Arsenious acid is prescribed internally by Delaval, Feuillette, Niederberger, Obich; and other alteratives, such as mercury, which we would not advise. Nor can we understand how any benefit is to be derived from diuretics and purgatives, and especially from the use of external emunctories, such as setons.

Corns.

Under this name is understood an alteration of the tissues underneath the hoof; of the heels of the horse's foot by lesions of the living parts in the movements of expansion of the hoof; by bruises, compressions or contusions. There is then a capillary hemorrhage which extends in ecchymosis in the hoof. A corn, then, is a bruise of the living horn at the extreme end of the branches of the sole, and especially in the laminated tissue of the folds of the bars. It is a very common disease, and one to which all horses are exposed. Some have them constantly.

Corns are seen mostly on the fore feet, and on the inside more commonly than on the external side. They are rare on the hind feet, because in the various gaits the weight of the body is carried more on the front legs and on the posterior part of the foot, while in the hind legs it is the front part which principally receives it.

I. *Divisions.*—Lafosse Sr., has distinguished them into *natural and accidental*, while Girard considers them all as *accidental*. H. Bouley designates as *essential* those which come from other than external causes. We believe that it would be better to establish the divisions on pathological and anatomical bases, and admit a

corn of the wall, or laminated, that which has its seat in the laminæ which unites the wall to the tissues underneath, viz., in the keraphyllous and podophyllous tissues of the heels and bars, and a *corn of the sole, or velvety,* that which has its seat in the velvety tissue which unites the sole to the fleshy parts. The laminated corn corresponds exactly to the "natural" of Lafosse and to the "essential" of Bouley. It is due to lacerations in the movements of expansion of a badly-made foot. The other is due to contusions. Whatever may be the adopted divisions, we, with Girard, and as admitted in practice, recognize in each category, the *dry,* the *moist* and the *suppurated* corn.

II. *Etiology.*—All feet are exposed, but not all predisposed to corns. They are more frequent in heavy feet, with those where the heels are high or contracted in which there is a motion of retraction of the hoof which interferes with the displacement backward of the third phalanx at the time of rest, and hence the lacerations are easy; besides, there is a continual pressure upon the living parts of the posterior region of the nail. Corns are frequently observed in excessively long feet where the hoof does not receive the moisture necessary to its elasticity; it then losses its suppleness and fails to assist the internal motions of the parts contained within. It is seen whenever the hoof is too dry, the posterior diameter of the feet being then diminished. Corns are seen on weak feet, on which the hoof is too thin to resist the dilating effect of the internal structure, and spreads excessively. Wide and flat feet, with low heels, in which the interior surface of the branches of the sole is on a level with the plantar border of the quarters and bars, are very often affected with corns. The pressure of the shoe or the roughness of the ground produce these bruises through the sole. Here the conditions are unfavorable to the normal dilatations of the hoof; the ungeal phalanx, being unsupported by the convexity of the sole, has a tendency to drop down lower, the tissues are easily lacerated and bruised in its displacement at the time the foot rests on the ground.

The most serious causes of corns arise from the shoeing, which not only sometimes gives to the hoof a shape predisposing to that disease, but also very often is a determining cause itself of these injuries. "As long," says Hartmann, "as horses will have corns, horse-shoeing cannot pass as an art, and their too frequent presence is an evident proof of our imperfect means of protection to

the hoof." Without shoeing there would be no corns, and it is in its irrational methods that the true causes of these accidents originate. It is by the greater or less frequency of corns that one may judge of the state of that art in a country.

The faults are found, 1st, in the manner in which the foot is pared, or in the shape which it receives; 2d, in the fitting of the shoe; 3d, in its application. In paring the foot, the sole is often weakened and thinned too much; it does not resist the pressure, and, at the time of resting the foot, all the weight of the body is thrown upon the point of union of the sole with the wall. Ordinarily too much has been cut away from the frog, and this not resting any more on the ground, no longer resists the pressure, and the lowering of the branches of the sole is then extreme, as proved by the experiments of Leisering. The custom of cutting the corns, and of cutting the hoof at the heels, acts in a similar manner; the posterior half of the foot is weakened, and that is the part which must carry the greatest part of the weight. One needs only to compare a foot from which the shoer has removed much horn at the sole, frog and bars, with one in which the hoof has been left alone for a long time. In making a vertical and tranverse section of the two in the middle of the frog, a little in front of the angles of the sole, he will see at once how weak the point of reunion of the sole with the wall has become, the means of resistance to the pressure of the weight of the body through the third phalanx being thus diminished, and consequently a predisposition to bruises created.

The shape of the shoe also contributes to corns; an excess of concavity; a shoe which from the last nail-hole is not flat to the heels, whose branches are too much inclined, contributes to the lateral contraction of the foot and gives rise to corns. In this case the shoe resists the play of the horny box, and by itself, through the sole, exercises a great pressure upon the tissues underneath. Too high caulks, in preventing the resting on the frog, cause an excessive pressure on the inside of the foot, and compel it to rest on the heels and the branches of the sole, which are too much lowered. The opposite excess, when the shoe is thin at the heels, as in the Coleman shoe—which is thick at the toe and thin at the heels—produces a similar result, because in increasing the pressure on the heels, it gives rise to bruises of the tissues through the retrossal processes, which comes down too heavily. A very

wide shoe, too thin, may also contribute to the genesis of corns, because, then, the shoe helping, with the intensity of the reactions on the pavement or on too hard and stony roads, the shoe soon gives under the foot, and compresses the sole and tissues beneath.

The manner in which the shoe is put on may also be a cause of corns; the shoe ought to rest exclusively on the inferior border of the wall, and not touch the sole; when it is too narrow it may be a cause of contusion or of contraction; if too wide it prevents the natural expansion. It is upon horses long shod that the wrong application of the shoe as a cause of corns is observed. As a consequence of the growth of the hoof, the shoe no longer sufficiently protects the plantar border of the foot, the heels of the shoe being inward and pressing on the branches of the sole; this is especially the case when the shoe is thinned by wearing; it yields, and easily bruises the parts of the sole on which it rests; high caulks, on a branch already too short, or too thin, act the more injuriously because, not being concentrated on the projection of the caulk, the branch gives away sooner, and presses still more on the heels.

The shoe becomes an indirect cause of corns, when hard substances, as stones or dry earth, are found between its superior and inferior face on the sole, or between the frog and the internal border of the branches of the shoe; this is a secondary cause, which was formerly considered of great importance.

The work of horses has a great influence, corns being very frequent in horses which work on pavements and stony and hard roads. They are rare in country horses, but common in those of great cities; a rapid gait contributes to their development on account of the great pressure on the ground. The seasons have also an influence, dry and warm weather depriving the hoof of its moisture, and by preventing its elasticity of motion, increasing the effect of pressure upon the tissues.

Emigration has been considered a cause of corns. Horses coming from the north of Germany are mentioned as having been rapidly affected by them after being in large cities. But if the change too suddenly made from soft to dry bedding is an effective cause, the mode of shoeing can also be considered as a stimulating cause. The same is true with respect to the African horses, which are generally free from the disease in their native country, but frequently suffer with them when brought to France, and submitted to a mode of shoeing so different from that of the Arabs.

III. *Symptoms.*—The ordinary symptoms of corns are noticed in the abnormal position of the leg at rest, in the lameness and the sensibility of the region.

When lame with a corn the horse carries the leg forward of the plumb line, and keeps it semi-flexed at the fetlock; he tries to relieve the painful region by resting; sometimes he manifests his pain by pawing and moving his feet from forward backward, pushing his bed under him. The lameness is not characteristic; it varies greatly in intensity, from a slight soreness to lameness on three legs. It is generally proportioned to the intensity of the disease. However, there are horses so accustomed to their corns that they do not go lame, while others are very much so for a trifling injury. Sometimes it is intermittent, and diminishes when the suppuration has made its way between hair and hoof. The sensibility of the heel—seat of a corn—is discovered by an exploration with the blacksmith's nippers. Sometimes it is made known by pressure of the fingers, the cases varying, of course, according to the severity of the disease. There is often heat, especially at the coronet, which may be tumified, particularly so when the corn is of a complicated suppurative character. To obtain an accurate view of the disease the foot should be well pared, and this operation may be greatly facilitated by the application of poultices for twenty-four or forty-eight hours previously.

It is only by the objective examination and the pathological anatomy, so to speak, of the corn that the moist or suppurative variety can be distinguished from the dry, and we shall find either a simple ecchymotic spot, or a complete disintegration of tissues.

IV. *Pathological Anatomy.*—The lesions vary according to the severity of the disease. In *dry corn*, we find an infiltration of blood in the horny structure. This is blood which has transudated through the laminated or irritated velvety tissue from the injured blood vessels. This blood gives to the hoof various tints, more or less pronounced, not unfrequently yellowish, according to the intensity and duration of the disease. The hoof sometimes loses consistency and becomes brittle; at others, it is hard and dry, and then resembles healthy hoof minus its coloration. If the ecchymotic spot involves the whole thickness of the horn, from its surface to its depth, it is an evidence of the continued activity of the cause. A deep mark indicates a recent injury; a superficial one is an evidence of an older corn, which disappears,

and then it seldom produces lameness. Sometimes the marks are arranged in layers, the healthy horn being alternated with others which are infiltrated with blood. This is a proof of the intermittent character of the acting cause which has originally produced the corn. The ecchymosis, however, is not the actual seat of the corn, which is more in the velvety and especially in the laminated tissues, which are torn or bruised, the blood escaping through the sole simply by the action of the laws of gravitation. It is rarely that this lesion is looked for in the case of dry corn, and it is usually ignored; but in the confirmed corn, a true alteration of the laminæ of the keraphyllous tissue is observed. This is replaced by a horny tumor, a kind of keraphyllocele, analogous to that of chronic laminitis, due to a union of the laminæ under the influence of the fibro-plastic exudation resulting from the inflammation, which is of varying size, and presses more or less on the sub-horny tissues. In some cases, this horn breaks up little by little, and gives rise to quarter crack. The ecchymotic spots of the dry corn may vary in size; they may range from the size of a pea to that of a ten-cent coin. At other times they may occupy the entire space between the bars and the walls of the foot.

In *moist corn*, there is not only hemorrhage, but also inflammation proper, with serous exudation. The hoof is colored, as in dry corn, of a brownish tint, due to the infiltration of blood which occured at the start; on searching deeper, one will discover between the hoof and the living tissues beneath a separation of varying dimensions, filled by citrine serosity. Most frequently this separation takes place at the line of the sole with the wall, and extends under both. The horny substance is then more or less impregnated with this serosity, and then has a charcteristic yellow appearance and a waxy consistency.

In *suppurative corn*, or more properly, suppurating, the inflammation ends in suppuration. The pus is secreted by the velvety and laminated tissues. It makes room for itself by gradually separating the hoof as its formation progresses. Before long it passes between the podophyllous grooves of the bars and of the quarters, the horny are lossened from the fleshy laminæ, and in its ascending progress the pus soon makes its appearance between hairs and hoof at the quarter, at the heels, or at the glomes of the frog. It is not common for the pus to make its way through a hoof of too thick or resisting a nature, unless it has first been

sufficiently softened by poultices and thinned down with the knife. This suppuration, in the generality of cases, brings on serious complication, by the excessive pressure to which the sub-horny tissues are then subjected. Gangrene of the velvety tissue near the branches of the sole and of the podophyllous grooves which have been lacerated in the suppuration, are very common complications. If the pus remains long in the hoof its gangrenous results may extend to the os pedis, the laternal cartilage, the plantar cushion, and even to the plantar aponeurosis, and give rise to necrosis or caries of the bones, or to quittor, to a more or less variable extent. This sub-horny suppuration, which may sometimes be considerable, as well as the complications accompanying it, are detected with the probe.

V. *Termination and Prognosis.*—Resolution is a common termination of corns. But their relapse is common also, especially in feet predisposed to them by bad conformation. A kind of chronic condition of the disease, and one which is more liable to become serious than the accidental variety, is the ordinary termination in this case. The mere extent of the disease is of less importance in the diagnosis than the predisposing conditions. Generally the dry corn is less serious than the moist one, and especially less than the suppurative. Complicated corns, principally in flat, wide feet, with low heels, by reason of uncertain, protracted and expensive treatment, are in general fatal, and necessitate the destruction of the patient.

VI. *Treatment.*—The largeness of the space we have consumed in considering the etiology of corns will compel us to be brief in our remarks upon the *preventive treatment.* Shoeing, which is so often the cause of corns, may also be made a means of preventing them, even upon predisposed feet, if performed with intelligence and proper observation, based upon the anatomy and physiology of the foot. Generally speaking, one must not proceed rashly by changing too suddenly the mode of shoeing. We do not think that any one specified system of shoeing will with certainty prevent corns, but we do believe that each case demands its special study and care. Usually, a flat shoe, and which has the heels rather thin but resisting, and which rests on the wall proper, even of the diseased one, if not too painful, is to be preferred. If the shoe is for a low-heeled foot, the heels of the shoe should be thicker in order to supply their insufficient height and to offer

more resistance to the weight of the body. Sometimes the protecting effect of the shoe must be completed by the use of a plate of gutta percha or leather between the foot and the shoe; india rubber does not answer, as by its elasticity it interferes with the resistance of the shoe. It is absolutely necessary to preserve the hoof in a sufficiently supple condition, to effect which tar, hoof ointments and other greasy substances are used. Flaxseed meal, poultices of cow manure and salt water, a damp bedding, tallow in the hollows of the heels, all are very good preventives and even curative means, which a careful hostler will not neglect. Paring the feet thin, as practiced by some, is very objectionable, and is a serious obstacle to the extirpation of corns. The feet should be pared as little as possible, especially at the heels or in the lacunæ.

As for the *curative treatment*, there are, according to H. Bouley, four indications to follow: First, remove the acting cause; second, treat the injury it has produced; third, relieve the pressure upon the diseased region, until it has returned to its healthy condition; fourth, prevent the return of the injury.

The first indication is easy to fulfill with the accidental corn, but often nearly impossible in that due to a bad conformation of the feet. The second indication varies according to the extent of the disease. Generally it is advised to thin down the hoof at the bruised part and its surroundings, so as to relieve the pressure on congested or inflammed parts. Still, we are not in favor of too much thinning of the hoof, and except under peculiar conditions, would practice it very slightly. Even in the moist corn, we believe in leaving to the hoof a certain protective thickness. The pressure can be sensibly diminished by the application of chloroformed oil, or of tincture of creosote; they very readily penetrate the hoof, and act directly upon the inflamed parts. We believe that excessive paring, the "cutting out of the corns," to use the shoer's expression, is injurious, and predisposes to new corns, by weakening the region and promoting a more rapid desiccation and contraction of the hoof. In all cases of dry and moist corn, one must avoid making the parts bleed, the exposure of the soft tissues, and all unnecessary cutting. Thinning is necessary in suppurative corn, and has to be done over the whole extent of the separation of the horn, and a wide channel of exit made for the pus on the side of the sole. It is a wise plan not to remove the

entire mass of the loosened hoof, as by this the dressing will be much facilitated.

Cold baths are useful in all cases of corns; at other times poultices of bran or other material are preferred. Sometimes sulphate of iron or of copper are added to the bath, especially in the moist corn. In the suppurative kind, when the suppuration is irregular, and when complications are likely to follow, warm and slightly aromatic baths are better, and after this, a dressing with tincture of creosote, renewed the same day or the next. Later, cold iron or copper baths may be used again; if the suppuration has broken out between hairs and hoofs, injections of Villates' solution, after free escape of the pus by the plantar surface, are indicated.

In the complicated suppurative corn these means are iusufficient. We must cut deeper, and for this the animal must be thrown. Then, when the diseased tissues are exposed by the removal of the loosened hoof, the nature of the lesion must indicate the requirements of the treatment. The velvety and podophyllous tissues, if gangrenous, must be excised as far as their diseased condition extends; carious bone is to be scraped, the fibrous and fibro-cartilaginous structures, if necrosed, are to be excised or cauterized, or sometimes left alone and watched, according to the peculiar character and extent of their lesions and the extent to which they exist. Once operated on, a dressing with plates and bands is applied, and the animal allowed to rise.

It is by a peculiar shoeing that, for some time, the painful heel must be relieved from supporting its part of the weight of the body, and protected from outside pressure. This is the "bar shoe." By the transverse bar, which unites both branches, it presents a support to the frog and protects the heels. The resting of the shoe takes place equally upon the wall of the toe and of the quarters, especially the external, and it does not rest on the diseased heels which may have been first cut away. Some veterinarians prefer the truncated, or the oblique bar shoe, or that with a bar forming an acute re-entering angle. Hartmann recommends the first; Mayer prefers the bar shoe in which the bar heels have been thinned down, and even hollowed, to avoid as much as possible the pressure on the diseased part; this shoe has sometimes given us good results in horses with a weak frog. In many cases ordinary shoeing answers; then the diseased hoof is pared down.

The branch of the shoe in this case requires a greater thickness. Whatever may be the mode of shoeing used much advantage can be obtained by the application of a sole of leather or of gutta percha.

Sandcracks.

Seime of the French; *Hornspalt* of the Germans; *Fissura* of the Italians—are fissures or solutions of continuity observed on the walls of the foot, ordinarily very narrow, which follow the direction of the horn. Principally observed on the hoof of solipeds, it has been seen also in ruminants, but rarely, and of little importance.

I. *Division.*—They may exist on every part of the wall. On the median line of the nail they are called *toe-crack*, and then are more frequent on the hind feet. They are rarely found on the outside or inside toe (the *mamelles* of the French), but commonly met with on the quarter (*quarter-cracks*), then situated on the lateral parts of the wall, toward the heels, and more frequently on the fore feet, especially on the inside. They are sometimes oblique, relatively to the thickness of the wall. Cracks are superficial or deep, according to the thickness of the wall involved. They are *complete* when they extend from the coronary band down to the plantar border; *incomplete* when more limited. In this last case, those which do not extend up to the skin are the more disposed to recovery, and will grow down with the growth of the wall, while those which extend to the coronary band are more serious, being continually aggravated as the growth of the hoof progresses. According to the date of their formation, they are called *recent* and *old*. *Simple* cracks are those which only involve the wall; they are *complicated* where there is more or less serious lesion of the tissues beneath, such as inflammation of the laminæ, hemorrhage, or caries of the bone. A serious complication is that of keraphylocele.

II. *Symptoms.*—Often the solution of continuity is the only one observed, and it is the special characteristic of the disease. But the fissure may be masked, either accidentally or by design. It may be concealed by the hairs, by the mud, or covered by hoof-ointment, tar, wax, or even a putty of gutta-percha. Concealed internal cracks have sometimes been discovered, such as fissures involving the internal face of the wall, which, consequently, were

not noticed from the outside, or showing but a slight depression on the surface of the wall. These cracks are only discoverable when the foot has been well pared down. As slight as the solution of continuity may be, it participates in the motion of dilatation of the foot, and it is better detected when the foot is raised than when it rests on the ground. This is the case when it is a toe-crack, but on the contrary, the quarter-crack is more open when the animal rests its weight on the leg, in which case, the separation of the borders of the cracks may be from two to four millimetres, and may expose the bottom of the fissure. Ordinarily, cracks appear first at the coronet, and there is then but a slight opening, but as they become older, and grow down, they have a tendency to become deeper and more complete. When of old standing, their borders are rough and scaly, having between them an ulcerated tissue and sometimes a fungus growth, from which escapes a sanious fluid. In other cases, as of quarter-crack, the edges have a tendency to cover each other.

Superficial cracks are not always attended with lameness; it is, on the contrary, often very severe when they are deep. The pain is generally in proportion to the depth and degree of opening of the fissure, and also especially to any complications which may exist in the tissues beneath. The lameness seems at times to be due to the injury of the deep, soft tissues, and to be caused by the motions of the horny box when they become pinched, irritated and bruised. The affected animals are especially lame when the foot rests on the ground, and the lameness is greater on a hard than on a soft surface. If an animal suffering with toe-cracks is moved on descending ground, the lameness is greater than on ascending a hill, the weight of the toe in the latter case producing less opening of the edges of the solution of continuity. In quarter-cracks, the severity of the lameness is always in proportion to the rapidity of the gait; many horses which are but slightly lame on a jog, become much more so when the gait is accelerated, the dilation of the heels being greater, and the separation of the b rders of the crack increasing in proportion to the speed. When there is lameness, there is naturally an increase of heat and sensibility of the foot, especially at the seat of the crack. This is often discovered by feeling with the hand; old cracks are generally accompanied by a thickening existing at a corresponding point of the hoof. A deep, but recent crack, is apt to be accompanied with

hemorrhage; there is blood which sometimes exudes between the borders of the crack, and flows in abundance when the movement is rapid; and old crack, in similar circumstances, may show pus, sometimes mixed with blood. A misstep, a sprain, may give rise to hemorrhage in cracks which are ordinarily dry. In toe-crack, the solution generally involves the thickness of the wall, through which it runs in a line almost parallel to the median plane of the body, while in quarter-crack it is often oblique and irregular, not exactly following the direction of the fibres, but following the thickness of the wall obliquely in such a way that the external solution of continuity is more posterior than the external. If the crack is rather old, and the foot where it exists is contracted, it is generally incurvated, one border covering the other, and sometimes they seem to be moulded on each other, so as to cover and conceal the true crack.

III. *Complications.*—Among these we may first mention the inflammation of the recticular tissue, which is first pinched and injured. This may be followed by suppuration and local gangrene. Very often the disease is followed by necrosis of the os pedis, and caries of varying depth. In toe-crack cases have been seen of caries of the tendon of the anterior extensor of the phalanges, and even arthritis, though rarely occuring, have been observed. In quarter-crack, one may have cartilaginous quittor and suppurative corns. As before stated, these lesions are indicated by the severity of the lameness, the presence of the blood or pus through the crack, and the extreme sensibility of the part. It is especially when, in the course of treatment, a part of the hoof has been removed, that the keratogenous apparatus has been exposed, that the abnormacoloration of the podophyllous tissue is seen, in its swollen condition and its sensibility to pressure, accompanied with the presence of the pus or sanious discharge, and at times the necrosis of the bone. Sometimes, also, foreign substances, as dirt or gravel, may be found introduced in the cracks, and acting as causes of irritation to the sensitive tissues below.

A complication, not so frequent, however, according to some authors, is that known as *Keraphylocele*, and which consists in an hypersecretion of horn, from the coronary band on the inside of the crack. Sometimes the horny growth remains separate from the borders of the crack, and is adherent to the wall only by its base, towards the coronary band; this is especially the case when

the wall has been thinned down or partly removed. In other cases it is adherent to the two borders of the crack, and this forms a natural cicatrix. This horny column, of varying length and strength, according to its age, presses upon the tissues beneath, and gives rise to severe lameness. With time there is corresponding atrophy of the podophyllous tissue, or even of the os pedis. This is often followed by a marked deformity of the hoof, and especially a deep fissure, parallel to the direction of the crack. The soft tissues under the keraphyllocele often in time become harder, in consequence of the disappearance of the papillæ; the hoof then is no longer adherent to the tissues beneath, and so incurable cracks are the result. A double wall or false quittor have often also been observed. Thus deformed, the foot is always subject to lameness, even if the crack is cured. Contraction or atrophy of the frog have been observed with quarter-crack.

IV. *Progress, duration, termination.*—Ordinarily, cracks once existing become worse. From being superficial and imperfect they become deep and complete as a natural result of the ordinary motions of the foot. If rest and some hygienic attention can be given, they may recover spontaneously, and disappear by the natural downward growth of the hoof. This fortunate termination, however, is principally obtained when the crack is due to accidental causes, without deformity of the foot.

V. *Prognosis.*—Simple cracks, superficial and incomplete, especially arising from the plantar border, almost always recover under rational treatment, which has for its principal aim the prevention of increase in the size of the fissure. Cracks starting from the coronary band are always of a more serious nature, with a tendency to increase easily. Still they are no longer to be considered incurable. Cracks in which the borders are much separated by the motion of walking; those which are oblique; those whose edges are incurvated inward; those where a portion of the wall is loose; those which bleed, and those where there is a continued irritation of the sub-horny tissues, are the most serious; and so much so, that they may require quite serious surgical interference, and after all baffle the best skill of the operator.

VI. *Etiology.*—The causes of cracks vary greatly, and are often multiple in a single case. Seldom the result of accident, they are most commonly the combined effect of both a predisposing and an extraneous cause. A frequent one among others is

the relative dryness of the hoof, which then becomes excessively brittle. We have seen the conditions in which the hoof loses its natural flexibility, and shall here only state that alternate changes from dampness to dryness have as much influence as the dryness alone. Cracks are more frequent in animals working along damp than in those pulling in dry and stony roads. They are common in animals which after being kept in pastures are placed in good paved stables, with dry bedding. It is principally in these conditions we find the quarter-crack. During some seasons, while a term of dryness follows continued wet weather, the conditions are favorable to their formation, and they often assume an epizootic form. Emigration to dry climates is a frequent cause, by producing the contraction of the ungueal structure. This last circumstance explains why cracks are more common in army horses, which are called to go on long journeys during the warm days of summer. But if the European horse taken to Africa suffers less from the disease, a similar result occurs to the African horse when brought to our climate. The Arabian horse readily contracts quarter-cracks in our stables, and with our shoeing. Animals with small feet, or with hard and thick hoofs, have a natural predisposition, which is also found in Hungarian, Russian or Tartar animals. Feet excessively large are also easily affected with the disease, especially those which have canker or grease.

Unskilful shoeing may predispose to cracks, and this is principally the case if the wall is thinned or rasped down too much; the same result is obtained from shoes which are too wide or too heavy, or which are kept on by too heavy nails.

Feet with toes turned outward are predisposed to it, as in these the weight of the body rests more on the internal quarter, which being thinner than the external, give way the easiest. Contracted feet are subject to it. Quittor, suppurative corns, and some other diseases, are also predisposing causes. Among occasional or accidental causes may be mentioned traumatism, contusions of the foot and blows during work. The service of heavy trucking for heavy horses exposes the hind feet to toe-crack, especially if the pulling is done in going up hill or on slippery pavements; mules' feet are very subject to it, and heavy falls in jumping and external blows are occasional causes.

Heredity in cracks has been mentioned. We do not admit this, except so far as it belongs among the predisposing causes

which may be transmitted, and we should object to an animal for breeding purposes though otherwise well-formed, if he were affected with cracked feet.

VII. *Treatment*—Prophylaxy ought to be the principal treatment of cracks. It is not always easy, however, to prevent them, and it becomes important therefore, to treat them as soon as they appear. One ought at least to try to prevent them from becoming complete and deep. This form of treatment may be called the hygienic, as it is not properly curative, and so long as the crack is not yet completely formed, the animal may be kept at work as if everything was normal. Curative treatment is that which is applied to the deep or complete disease, more or less complicated, and it most commonly consists in removing that portion of the wall which bruises and irritates the tissues beneath, and in equalizing the wound. In general, there is no necessity for haste in operating, the hygienic treatment being often sufficient to obviate the need of serious operations The distinction between the hygienic and curative treatment is not, however, always definitely marked, and quite often the two modes of treatment must be combined, both the hygienic and the curative being necessary.

The *prophylactic* treatment consists specially in the application of tonics, with the object of preventing the hoof from drying. Its normal hyrogoscopic condition must be preserved, and it must be prevented from taking up too much of the dampness of the ground upon which it travels, as well as from losing that which keeps up its flexibility. At times it must be rendered more moist and, according to the requirements of the case, recourse must be had to hoof ointments and other greasy substances, glycerine and astringent poultices. At the same time the shoeing must be carefully attended to ; the shoe must not be too heavy nor too wide, and should be secured by nails of a proper size.

The *hygienic* treatment has for its first and principal indications to prevent the solution of continuity from increasing, from extending through healthy structure, and especially to new hoof, as this is secreted by the coronary band. The borders of the cracks must be prevented from separating in the movements of dilatation of the foot. The normal suture of the wall not being produced by the natural process, or at least producing it only in keraphyllocele, which is likely to be as injurious as the crack itself, the borders of the crack must be brought together artificially.

It has been supposed that this could be done with the putty of Defay's, a mixture of gutta-percha (2 parts) and gum ammoniac (1 part), introduced into the well-cleaned fissure, and pushed in as deeply as possible by a warm iron plate or a spatula. This putty is excellent for superficial cracks, but is insufficient to bring the borders together when the fissure is somewhat deep, or especially if it is irregular and sinuous.

A better way, at least for toe-crack, is that which consists in suturing the edges of the solution of continuity by metallic clasps, which immobilize the hoof. This mode is always preferable to circular ligatures of wire or cord, which have the effect of interfering with the natural elasticity of the hoof. Clasps only fix the hoof locally, and are an old means of treatment, having been used by Solleysel and Garsault.

It was advised to perforate the horn through and through with a small punch, and pass a wire, which was bent over the crack, or twisted together at the ends. The same authority recommends the driving of a nail through both edges, and securing it tightly, as in the application of the nails of the shoe. This treatment was recently recommended by Haupt, Lafosse and Rey. The first of these professors takes an ordinary nail, with a small head, drives it through one edge of the crack, so as to come through the other at an equal distance from the point of entrance; the nail being thus driven to the head the borders of the crack are then brought together, and the nail secured in the ordinary way. Two or three of these clasps are employed, according to the extent of the crack. Lafosse makes a groove on each side of the fissure about one centimeter from the border, in a direction transverse to that of the fibres of the wall, which limits the passage of the nail. The nail is then introduced and secured as in the first instance. Rey makes a track for the nail first, by drilling a hole through the borders of the crack. The animal must be cast during these operations.

The best kind of clasps or hooks are undoubtedly those of Vachette, which require special instruments for their application, but give a real solidity to the means of fixing the position of the parts. The clasps are all prepared, made of strong wire, bent at both extremities, and slightly sharp inwardly (Fig. 489). These are secured on the foot by a special nipper or forceps (Fig. 490) in the notches made on the wall with a special cautery (Fig. 491);

this cautery has its extremities flattened, the width of the clasp, apart from each other. The forceps used to secure these is strong; its branches are flattened from side to side, and grooved inward, and sufficiently apart from each other, while it is open, to receive the clasps between its border; these branches, with the clasp, are exactly fitted to the notches made in the wall with the cautery.

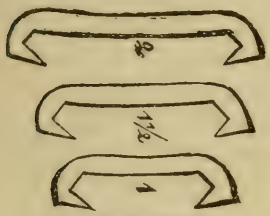


FIG. 489.—Clasps.

FIG. 492.—Clasps applied in the Thickness of the Wall.

FIG. 490.—Forceps of Vachette.

FIG. 491—Cautery of Vachette.

It is sufficient to press the branches of the forceps to close the teeth or extremities of the clasps, and bring firmly together the borders of the cracks. The number of clasps varies according to the case under treatment.

A very simple mode of effecting reunion of the borders of the

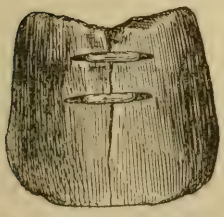


FIG. 493.—Toe Crack secured with Clasps.

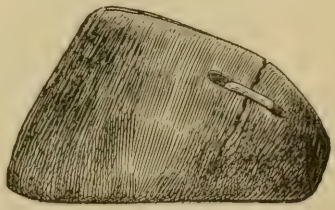


Fig. 494.—Quarter Crack secured with Clasps.

crack is that of Hartmann. It consists in applying upon the wall a sheet of iron, adapted to its outside, and secured on the foot by two small screws.

Clasps are of a certain utility for toe cracks, but they often fail in quarter cracks, on account of the thin condition of the wall, which is particularly well marked in some feet. If the living tissues are encroached upon, the clasp may give rise to complications, and still it is in that region that the effect of the motion of the hoof must be prevented, and where immobility is essential, to prevent the separation and spread of the edges of the crack.

Castandet has indicated a mode of treatment which has proved very successful, and which may be applied to both toe and quarter crack, where the fissure of the wall extends from the coronary band to the lower border of the foot. It consists in making a groove at about one centimeter on each side of the crack, which in depth extends to its bottom, which, when reached, is white. If the solution does not go to the lower border of the foot, these grooves are made obliquely, and so as to meet together at their lower termination, and form a V-shape. Thus the crack cannot increase, and it grows down without injury to the soft tissues. Castandet, after this operation, cauterizes the coronary band.

The transversal groove, recommended by Levrat, which cuts the tissues in two and extends beyond the crack on each side about three centimeters, which goes down to the soft tissues of the foot and not beyond them, has for its object to diminish the effect of percussion produced by the contact of the foot with the ground. It, however, does not prevent the edges of the fissure from separating, as the groove of Castandet does. It is chiefly useful when there is a separation of the wall, or false quarter. At times a transverse groove has been made to prevent an incomplete fissure, starting from the plantar border, from spreading to the coronary band. According to Hartmann, a single hole drilled through the wall is, in most cases, sufficient.

Shoeing is of much assistance in the hygienic treatment of cracks. In toe cracks, the toe should be spared as much as possible while the heels are lowered by paring, or by the application of a shoe thicker at the toe, or by the removal of the calks at the heels. While Defays holds that the shoe ought to lie close and tight to the plantar regions of the crack, Hartmann, on the contrary, advises the paring of that surface at the toe, so that the shoe

cannot rest on the crack, and recommends the application of two clips on each side of the toe.

In quarter cracks, it is recommended to lower the toe, to save the bars and the frog; and when the crack is incomplete, and not accompanied with lameness, Defays recommends not to lower the diseased quarter, and to have the heels resting well on that branch of the shoe which shall be thick and straight. Schrebe advises a calk on that side. If the crack is deep, with excessive lameness and deep lesions, the quarters and heels must be pared down as much as possible, and a bar to be then put on, resting on the frog, if need be. An ordinary shoe, with a thick branch, may be sometimes employed.

As part of the hygienic treatment, we may consider the means recommended to increase the secretion of the coronary band. It is known that a slight irritation at that part of the foot is accompanied with an increased secretion of hoof, which is sometimes sufficient to give rise to a new growth of healthy horn. One of the most common methods is to slightly cauterize the coronary band with the iron. This was already known by old practitioners, who employed an S cautery; but they committed the error of burning the hoof too deeply instead of simply cauterizing the coronary band. Solleysel speaks of the cauterization of the band. Garsault mentions only the burning with three S's across the crack. Such cauterization could have no useful effect, and the deep application of the cautery might be followed by serious complications. For these reasons Lafosse objected to them. In our days it is abandoned, and the coronary band only is touched by the cautery; Castandet and Rey also employ it. Chemical cauteries have also been recommended, nitric acid by Laguerriniere, and more recently by Lafosse.

Putty of corrosive sublimate and ointment of oxide of mercury are also in use, but have no marked advantages. Blisters prove very beneficial, and also turpentine, as recommended by Lafosse and Rey, and the oil of Cade by Maury. Defays advises the putty of gutta percha, which is also used to conceal the clasps.

The *curative* treatment is necessary whenever any complication attends the crack. If it is recent, antiphlogistics and rest should be first tried; cold bathing, blisters combined with hygienic treatment may then be sufficient. A single groove at the upper part of the crack, near the coronary band, is often sufficient, or a re-

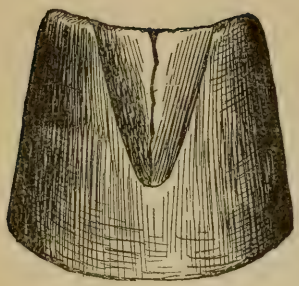


FIG. 495.—Operation of simple Toe Crack by the process of thinning down the wall in V-shape.

moval of a V-shaped portion of the hoof, extending more or less deeply, according to the condition of the crack, care being observed to avoid the growth of vascular granulations between the edges of the crack. There are cases where it is not necessary to remove the segments of the hoof entirely down to the soft tissues, but only to thin them down and to apply over it a dressing of oakum, secured by several turns of roller bandages. In all cases a bar shoe must be applied to relieve the pressure on the quarter where the crack exists. This is principally recommended by Prevost, Girard and others.

If there are deep lesions of the sub-horny tissues, a piece of the wall must be removed, and the operation for radical cure be performed. It is an old operation, by which all diseased tissues are exposed. As little of hoof as possible is removed. In operating, two grooves will be made alongside and at some distance from the solution of continuity. The wall between is removed so as to expose the podophyllous tissues from the coronary band down to the sole, care being taken to avoid the tearing of the structure of the coronary band, and the diseased tissues are then removed. If the podophyllous tissue, it is excised with the sage knife; if the bone is carious, it is scraped with the drawing knife. The whole

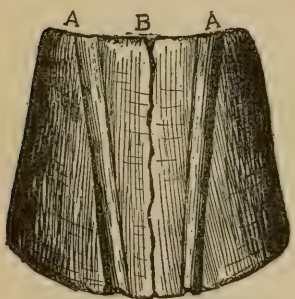


FIG. 496.—Operation for Complicated Toe Crack *B*, by removal of a piece of the toe of the wall. *A A*.—Oblique grooves limiting the size of the piece to remove.

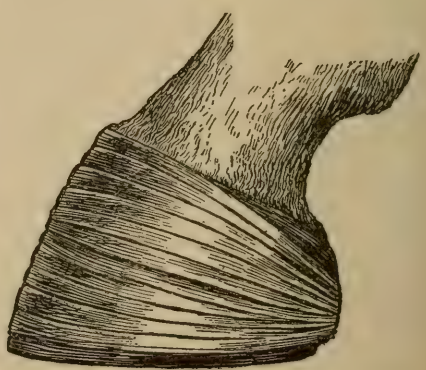


FIG. 497.—Dressing for Complicated Toe Crack.

is then dressed up with a shoe having the toe thinned down, and extending somewhat beyond the border of the foot.

The cicatrization does not take place from the coronary band alone, but also from the horny secretions of the podophyllous tissues. The repair is then quite rapid. The first dressing is removed after eight or ten days, and if everything goes on well need not be changed more than once a week.

The animal is not to be put to work until the hoof has obtained a certain consistency.

The operation for quarter crack is similar, except that only one groove is required in front of the crack, the tissues being exposed as in the operation for the removal of the lateral cartilages of the foot.

Calk.

Synonyms.—Kronentritt (Ger.)—Atteinte (Fr.)—Thus is called a contusion, with or without wound, that the animal receives on the coronet, from the shoe of another foot, or from a foreign body, or by another animal walking behind or alongside him.

The skin of that region is very thick, slightly extensible, not easily yielding to the imflammatory swelling; there is commonly sloughing and mortification of tissues, accompanied with violent pain. It is frequent in animals that forge, also in very young horses or those which are weak in the lumbar region, and which interfere and cut themselves in walking. This lesion is also very common in the districts where horses are shod with high calked shoes, when the wound resulting from it is made by the internal branch of the shoe, which lacerates the skin of the coronet. Horses shod to travel on ice are commonly affected with it; the injury being more or less serious according to the size and sharp condition of the calk.

Horses ridden in ridding schools are often affected with it during the various evolutions of the *haute école.*

It is called *single* when the wound is slight; *concealed* when the pain is great and continued, as in the case where it takes place on the tendon, near the heels or the quarters; *horny* when the contusion has taken place on the wall or at the coronary band; *complicated*, when it is very serious and accompanied with other more severe lesions. It is always a horizontal wound or a tumor by contusion.

I. *Symptoms.*—It is ordinarily recognized by the wound or swelling which exists upon the parts. Often the horse is lame, and the affected part warm and painful; sometimes the hairs are cut, the skin scratched or torn. There may be a slight bleeding at the seat of the wound. When the wall has received the contusion, the vascular network underneath may become inflammed, and then pus is formed between the teguments and the hoof, which then become separated. Sometimes even the lateral fibro-cartilage of the foot becomes irritated and swollen, and ulcerates, especially when the contusion has taken place on that part where the cartilage is; in this case the injury may be complicated with cartilaginous quittor.

In severe cases, one may recognize a *furuncular* calk, characterized by the mortification and sloughing of a portion of skin at the place where the contusion took place; it is the cutaneous quittor of old hippiatry, with formation of a core; this is always very painful, and the inflammation generally spreads underneath the wall. Bouley calls it *gangrenous* when there is unlimited similar mortification of the tissues; in this case the slough involves large portions of the skin. At times it may be called *phlegmonous*, when an abscess forms itself under the skin, then the coronet is warm, thick and inflamed, and the pain is extreme. Then if an incision be made through the dermis in its entire thickness, an abundant bleeding takes place, generally followed by the resolution of the disease; if there is already suppuration, it is at the same time immediately allowed to escape.

II. *Treatment.*—If the injury is slight or recent, whether with or without wound, very cold water and the removal of the cause by taking off the shoe, are sufficient to bring on a cure. But if the contusion has been great and deep, recovery is more difficult to obtain on account of the suppuration which will follow. Then the application of poultices is indicated; if there is formation of a core, and mortification of tissues, poultices of honey are especially indicated; in case of phlegmon, the poultice must be warm, and then incisions and counter opening must be made for the escape of pus; afterward dressings are made with oakum saturated with tepid wine or tincture of aloes.

When the caulking is horny, the use of emollient topics is insufficient; an excellent way then is to obtain the required sloughing of the tissues by actual cauterization—the iron heated to white

heat; by thus destroying a portion of the hoof and the soft tissues one will avoid the excessive pressure at the coronary band; this may also be prevented by the thinning down of the wall with the sage knife; but one must be careful not to remove too soon the portions of horn which may be detached.

When the calking takes place at the heel, it is good—so as to prevent other complications—to pare the foot down, especially at the heel, to remove the divided hoof and transform the wound to a simple one which can be dressed, as already stated, or with digestive ointment secured by several turns of a roller.

When there are wounds of the teguments, it sometimes happens, if the immediate union has not been obtained, that the portion of skin forming the inferior edge of the wound turns down and that the granulations protrude, tending to form a kind of fungoid growth. Chabert says that these must be cut off and dressed with oakum soaked in alcohol.

Calking at the hind feet being the most severe, and those which are followed by the most serious complications, on account of the urine and droppings of the animal, which impregnate the wound, one can never be too particular in keeping them clean and dressing them well. When they end in cartilagious quittor, they must be treated as that disease usually is.

As to the means of prevention, they consist in not placing the horses too close to each other in stables, fairs, etc., in not forcing them too much in their gait, in shoeing properly those which forge or interfere, and in placing or riding them in such a way as to avoid the possibility of their wounding each other.

Punctured Wound of the Foot.

Synonyms.—Naglebritt (German)—Nail in the foot (English)—Clou de rue (French).—In veterinary science this designation has been given to a punctured wound, often with laceration, sometimes with contusions, either at the sole or frog of the foot of the monodactyles, and produced by sharp or cutting bodies, most commonly nails, upon which the animal steps. The form of these bodies, the direction they take, the force with which they penetrate, and the part of the sole they enter, give rise to various lesions of varying gravity as they are older or as the injured part enjoys a greater sensibility.

Etiology.—Nails, stumps of nails, are most often those which

are picked up in the streets; at other times it is a metallic substance elongated and sharpened; again, there are pieces of glass, or other substances, such as bones or sharp stones, which are picked up and produce the wound.

It is principally in the streets of populous cities, in the yards of builders, or on the grounds where buildings are pulled down, that horses are liable to receive these injuries. In rural districts they are rare, comparatively, to what they are in cities.

It is evident that horses with wide, flat, thin, softened hoofs are more exposed than those which are of different structure.

I. *Divisions.*—Punctured wounds of the foot may be *simple* or *superficial*, *deep* or *penetrating*.

One of these bodies piercing into the frog requires to go in deep to be serious, as above the frog (which is itself quite thick, though formed by a soft and flexible horn) is the plantar cushion, a fibrous, soft and elastic mass, which offers a great resistance. If, however, the injuring body is a very long nail, which runs perpendicularly in through the frog at the plantar cushion, it may reach the terminal extremity of the perforans tendon, situated immediately under the plantar cushion, and penetrate the sesamoid sheath. It is known that this sheath forms a sac of some dimensions, that it extends above and below from the inferior half of the coronary to the semi-lunar crest, and in its transverse axis extends from one retrosal process to the other; the inferior portion of this synovial bursa covers the plantar aponeurosis in its whole extent. Sometimes, again, the puncturing body penetrates as far as the bone; sometimes the navicular; at others the os pedis, and sometimes even penetrates into the articulation.

II. *Symptoms.*—They vary according to the seat of the lesion, its depth, the mode of action of the penetrating body, length of time it has remained in the wound, and the nature of the lesions it has made; all conditions which may change the character of the disease from a first degree, when the animal shows no evidence of pain, to the extreme point, where its life is in danger, and evens ends in death, by the excessive local alterations and the sufferings accompanying it.

Often the first point which assists in the diagnosis of the case is the *history*. The driver has seen the horse become suddenly lame, has examined the foot, and found a nail more or less deeply imbedded; or it is the surgeon who finds the nail in its hiding-

place. The exploration of the part shows with certainty the nature of the lesion, the direction and depth of the wound, as well as the physical condition of the body which has made it, and all circumstances which allow a positive diagnosis to be made.

Quite often the nail is no longer in the foot; sometimes it has left its mark—an opening which can be explored; often this is not visible at first sight, though the wound may be even deep; this is when the injury to the hoof has been very slight, and when the hoof has retracted on itself by its elasticity or when the opening is concealed by the dirt of the streets. It must be remembered that sometimes the penetrating body remains broken in the soft tissues after its entrance through the hoof. If the accident is recent, only a little blood may be found—liquid or coagulated—over the wound; later, some serosity, more or less purulent, is observed; the pus is white or black, sometimes mixed with synovial fluid; sometimes there are granulations on the bodies of the wound which protrude over the edges, commonly called proud flesh. Such are the first objective symptoms obtained by the exploration of the parts. Ordinarily they are insufficient, for it is not always easy to probe the wound. It then becomes necessary at the beginning to pare off the hoof all around the wound, and sometimes to hollow it at the point of injury, without going to the sensitive structure, however. In this way the exploration and the probing of the wound are rendered much easier.

The pain, expressed by the lameness, is almost always manifested; it varies according to the seat of the lesion and its depth. At first the intensity of the lameness does not give the exact measure of the disease, and often one may be led into error by it; but it gives an exact value of the lesion when a few days have elapsed since the injury was received; if the pains are slight or absent, they indicate that the reparative process is going on well; it is, on the contrary, interfered with by complications when, as time goes on, the lameness increases instead of becoming diminished. Generally one can say that the injury will amount to nothing when the lameness is slight, while, on the contrary, serious complications must be always looked for when it is great and remains on long, even when the first lesion has been slight and superficial. The wound, which has penetrated through the hoof only, has no symptoms, no sequelæ; the animal is not lame from it, or if he be the lameness is very slight, the foot resting entirely

on the inferior surface; when the resting takes place only on the toe, ordinarily the tendon is injured, possibly the synovial sheath; in cases where high inflammation exists the pain is very great, the animal walking on three legs only.

The anatomical examination of the injured part teaches that the most serious punctured wound of the foot is that of the centre of the foot, where the tendon, synovial sac, and where the articulations may have been injured. Forward of this the wound is less serious, even if it involves the bone. Posterior to it, it can only injure the plantar cushion. Under this condition the plantar region of the foot is divided into three zones; one, anterior, from the toe to the point of the frog; one, middle, extending from the first to the median lacunæ of the frog; and the third, anterior, covering the space left back of this to the heels.

The most serious of the injuries to which the foot is liable are those caused by foreign bodies which penetrate the middle zone, that being the most complicated portion of the structure. The symptoms will vary, according as the wound extends to the plantar aponeurosis, or only as far as this membrane; or lacerates the soft surrounding tissues without touching it; or it goes beyond this and injuries the small sesamoid sheath, or even going deeper, severs the navicular bone, or its ligamentous attachment to the os pedis; or reaches the last phalangeal articulation.

A wound of the plantar aponeurosis is always very painful, especially when complicated with necrosis, in which case there is no weight put on the diseased leg, and continual lancinating pains and reacting fever are soon observed. The wound is then fistulous in character, and the suppuration then flowing from it meets with difficulties in its escape, which gives rise to a state of general inflammation, and the foot becomes hot and very painful If the necrosed scar becomes loose and sloughs off, being detached by suppuration, improvement soon ensues, but as the necrosis of the tendon has generally a tendency to spread, there is an increase in the character of the symptoms. If the wound extends to the sesamoid sheath from the start, the synovial fluid is observed escaping, first pure, but soon becoming milky and purulent in aspect, if the sheath has become inflamed, and easily coagulated in yellowish clots. The pain is then very great, much more so than when the aponeurosis alone is diseased. At times, by rapid closing of the plantar wound or obstruction of the fis-

tula, a warm swelling forms itself in the back of the coronet, which raises the skin by degrees and becomes elevated, prominent at one point, and giving a feeling of fluctuation. This swelling ends in ulceration, and allows the escape sometimes of an abundant synovial, purulent discharge.

The wound of the small sesamoid and of its ligament adds nothing to these series of symptoms. The probing of the tract will only determine it by the sensation of roughness which it will give; but generally one must be careful in using the probe, especially when the flow of synovia is absent. If the foreign body has pierced through the ligament, or has penetrated in the coffin joint, phalangeal arthritis is the consequence. The same result is likely to follow excessive inflammation of the foot and the macerating effect of the suppuration, in which case the tendon may soften down and give way. It may then also happen that this tendon retracts by the contraction of the muscular fibres, and can then be traced upward to the back of the coronet, or of the fetlock, according as the giving way has taken place higher or lower.

With arthritis there is a hot, painful swelling of the whole coronet, with diffused œdema above the fetlock and the cannon, and extending upward to the whole leg, complicating the lesion by lymphangitis, and painful swelling of the lymphatic glands. Then subcutaneous abscesses are found round the coronet, with gangrene of the tissues; while, again there may be only an extensive fibroplastic exudation, which ends in calcarious organization and anchylosis.

In the anterior zone the only serious lesion met with is caries of the os pedis, characterized by great pain, continual lancination, loss of the use of the leg, and high reacting fever. There is abundant bloody and fœtid suppuration, and the probe gives the sensation of the soft resistance of the bone, of its rough condition, and its partial fragility. The caries having most generally a progressive march, complications of separation of the hoof, to a varying extent, are often seen; the pus arrives at the surface between hairs and hoof; and diffused gangrenes are also often seen, which extend as well to the podophyllous as to the velvety tissues.

In the posterior zone, the only serious wounds are the lateral ones, which may injure the fibro-cartilage and become complicated with their caries or quittor and fistula down to the lacunæ of the frog, as we have seen in suppurating corn.

Nails may penetrate the posterior zone through and through, coming out behind the coronet, without danger. The sub-horny suppuration may detach the frog and be the only serious complication to be met with.

As *terminations* of all these injuries we may see resolution, suppuration, gangrene, softening of the tendons and phalangeal arthritis, and as sequelæ, bony tumors of the coronet, and anchylosis. The most serious complications are the dropping of the entire hoof, the rupture of the tendons, tendinous and cartilaginous quittors, for the injured hoof, and chronic laminitis for the opposite one.

IV. *Prognosis.*—This varies according to the seat of the wound. Less serious in the posterior than in the anterior zone, it is less in the last than in the middle, where the region is so complicated and the nature of the tissues so different. The depth of the wound has also some influence on the prognosis. Wounds of the plantar aponeurosis are more dangerous than those of the plantar cushion; those of the sesamoid sheath are more so than those of the aponeurosis; they are still more serious if the bones are affected; the worst of all is that of the joint. The direction of the foreign body and its simple or complicated action, will also influence the prognosis.

This, we have already said, can be established by the severity of the lameness. The nature of the foreign body must also be taken into consideration; if blunt, which crushes the tissues, it is more dangerons than if sharp and pointed. In a flat or convex foot, punctured wounds are more serious than in a well-made foot. They are less serious in heavy than in light draught horses, as the former, though they may remain lame, are still useful. The excitable condition of a patient will also alter the prognosis. Wounds of the anterior feet are more serious than those of the posterior.

V. *Treatment.*—In all cases, the first indication is to obtain a natural cicatrization and natural repair, always more rapid and perfect than that which is gained by surgical interference. This is generally easily secured, and for this reason it is important to avoid too severe manipulation upon the injured foot. One must watch the progress of the disease, give the foot as much rest as possible, remove the shoe, thin down in its whole extent the plantar hoof, so as to avoid any pressure, and keep the foot in a cool-

ing bath—ordinary cold water, to which often is added acetate of lead, sulphate of iron, or common salt, very beneficially. Poultices, cold preferable to hot, give excellent results. By this treatment, the progress of the inflammation is checked, and very often deep and serious wounds, even those where the tendinous sheath has been injured, are easily cured. If the lameness gradually diminishes, the case rapidly gets well; at any rate, by this treatment, the inflammatory process is diminished, and the painful pressure of the hardened and thick hoof is avoided.

In the winter, when cold baths are of difficult application, chloroformed or carbolized compresses may be applied round the foot. The hoof is thus softened and the pain reduced. At other times a blister is applied round the coronet.

If the lameness remains, or seems to increase, it is due to tendinous necrosis or caries, and it becomes necessary to operate. Must the surgeon then have recourse to an operation, and make a simple wound with his sharp instrument? Or, is it still better to merely depend on natural resources, and assist them?

It is difficult to lay down any special rules. If the disease is old, if the necrosis has progressed and is still increasing, a serious operation becomes necessary. If the necrosis is recent, one must be guided by external indications. Notwithstanding (Renault remarks) one should not be too hasty, as the animal must necessarily be laid up for several months afterward. It is often sufficient, in a recently punctured wound, in order to avoid complications, to modify the conditions of the fibrous tissues in the whole extent of the lesion, by applying substances simply antiseptic, or still better, slightly caustic. Rey employs the cold bath, in which he dissolves a pound of sulphate of copper for ten or fifteen quarts of water; by this means he has secured the speedy recovery of severe punctured wounds. For a long time, and with the same object, we have been using a mixture of equal parts of sulphate of copper and sulphate of iron, having first hollowed the foot downward around the source of the puncture, and the sole being pared down as thin as could be borne.

H. Bouley prefers the application of pulverized corrosive sublimate; after tracing the wound to its bottom, he fills it well with the powder. This remedy was already recommended by Solleysel, who used it in caries of the os pedis. Other practitioners prefer phenic acid, and claim for it great advantages. By the action of

the caustics upon the fibrous tissues exposed to necrosis, or already in that condition, a double salutary result is obtained; first, the transformation of the part, which is the seat of a progressive gangrene, into a chemical eschar; and, again, promoting the more active vascularization of the surrounding parts, and consequently their increased power of healthy reaction; conditions twice favorable to the sloughing of the eschar, and the process of repair following it.

When the wound has reached the os pedis, and this has become carious, a portion of the sole is removed, so that the suppuration can escape, the bone is scraped off, and a dressing of carbolized alcohol applied, kept on by a thin shoe or slipper, with tin plates.

When there is a fistulous wound, through which synovia escapes, yet not purulent, caustics are recommended. Solleysel preferred these, but blacksmiths used them so carelessly that they soon were discarded. Since, however, they have been employed again, not in powder, but as trochiscus. Rey recommends the corrosive sublimate in conic pencils, introduced to the bottom of the fistula; by them he obtains an eschar, a solid clot, from the synovia, which closes up the wound and prevents the synovial flow, at the same time stimulating the granulations which close up the fistula.

We have already said that these measures must be used only when the synovia is not purulent, as then the escape of morbid liquids may be prevented. It is not then uncommon to see abscesses forming at the back of the coronet; generally not so serious as is usually believed; not as much as those which take place in front and which are due to suppuration of the articulation. After the running out of those abscesses, sometimes the wound of the foot assumes a better aspect, the symptoms improve, and the animal recovers rapidly. Injections of a very weak solution of tincture of iodine, as well as the baths of copper or iron, are then very advantageous. Hertwig advises the introduction of a seton through the sesamoid sheath

This treatment is not always sufficient, especially where the lesions are deep. All the diseased structures must be then exposed, and they must be removed and the wound changed into a simple one, which, well dressed, will heal without difficulty. The operation is required in proportion to the extent and nature of the lesion, and if this is recent and comparatively superficial, if a piece of the foreign body yet remains in the wound, or if its re-

moval has resulted in the sloughing of a small piece of dead tissue, it may be sufficient, the foot being pared thin, as already advised, to simply make an infundibuliform opening, various in size, so as to expose the bottom of the wound. For that purpose, the drawing knife or the sage knife is used, a light shoe is put on, and a dressing of digestive ointment, ægyptiacum, or simply alcoholic mixtures, are kept on by plates. At times it is advantageous to assist the process of sloughing by the use of caustics, sulphate of copper, Villate's solution, tincture of iodine, etc. If the wound is near or at the heels, the branches of the shoe are shortened and an appropriate dressing is put on. Subsequent dressings require the same care. Cicatrization goes on and the hoof soon returns to its normal condition. Sometimes the surgeon is called only when the inflammation is far advanced and suppuration already established. This peculiar condition is manifested by the swelling and heat of the parts, the acute pains, and often the high fever. The wound then must be at once enlarged and the pus allowed to escape, and this is the true operation for deep punctured wounds.

The operation becomes more serious if there is separation, partial or total, of the sole or frog, with a more or less advanced disorganization of the tissues underneath. If there is escape of purulent synovia, extensive cuttings are to be made.

In olden times, to perform the operation of the deep punctured wound, the entire removal of the sole was performed, without distinction or exception and notwithstanding the severe pain following it. In our day, a portion of separated sole or frog only is taken off. This is done by slices, and only so far as necessary for the other steps of the operation.

This operation is indicated when there is great pain, continuing without regard to what treatment has been followed. It is also when the plantar aponeurosis has assumed a greenish tint, diffused in its extent, without indication of a repairing process, with the marks of sloughing of the dead structure. The instruments needed are various: sage knives, single and double; drawing knives of various sizes: a directory, bistoury and forceps.

The animal, properly secured, and placed under anæsthetics, if too irritable (Bouley), the horny structures are removed wherever the suppuration has separated them from the soft tissues beneath, or the sole is only pared down thin, as well as the horny frog in its whole extent.

This first step of the operation completed, the operator introduces a director into the whole tract of the fistula, and with a sharp sage knife a longitudinal incision is made, following the canula of the directory as a guide, above and below the fistulous opening, and in the direction of the antero-posterior axis of the foot. This done, with the sage knife held in full hand, with one cut the surgeon, by a deep incision, removes the greatest thickness of the tissues all around the longitudinal cut he has just made, transforming the fistulous tract into a conical infundibulum, whose apex is at the bottom of the wound. If then the aponeurosis is not yet exposed, the operator removes with the forceps and bistoury whatever tissues still cover it.

Then follows the excision of the aponeurosis. This is measured by the extent of the necrosis. As a rule, it must reach a little beyond the diseased part, and by that operation the purulent synovia finds a free chance to escape.

If the sesamoid is sound, it must be left alone, but if the diathrodial surface is roughened, ulcerated and on the way to desquammation, it must be scraped off with the narrow and long drawing knife.

The complications of arthritis cannot be interfered with by the surgeon. It is by general antiphlogistic treatment, and by local and external applications that they must be treated.

The operation ended, the dressing follows, and becomes one of the most important parts of the means of recovery. As light a shoe as possible is placed on the foot, a coat of hoof ointment, Venice turpentine, or tar, is applied upon the thinned sole; pads of oakum, wet with alcohol, carbolized or not, are then carefully laid on the soft parts.

Some practitioners cover them with œgyptiacum (Mandel); others simply with Venice turpentine (Lafosse).

The pads or balls of oakum must not be too thick or hard, as no pressure is needed. The whole dressing is retained by plates, and several circular straps of tape above the coronary band. Cold water baths are always good afterward.

In the subsequent dressings one must bear in mind that the work of repair, the granulating, is more rapid in the tissues of the plantar cushion and fleshy sole than upon the bone and tendinous tissue; and that in this case it is longer than upon bone if this has been scraped. The result of this is a wound which presents

various aspects in its progress of cicatrization. It often has a handsome granulating appearance over its entire surface, while at the bottom there may be a clot of coagulated synovia covering the surface of the sesamoid and the edges of the wound of the plantar aponeurosis. A free escape of synovia must always be facilitated, and often the development of the granulations has to be controlled. If the cicatrization proceeds well and regularly, dressings need be changed but seldom, being satisfied with the cold bath, with copper solutions.

Dressings can be made with tincture of myrrh or aloes; sometimes in the centre with tincture of iodine. At times caustics are again used, while at others, fragments of bone or of tendon have to be excised.

The entire closing of such a wound may sometimes take place in a month; but often, even without complications, two or three are required. Complications may easily make their appearance and interfere with the cicatrization. Sometimes pieces of necrosed tissues which remain at the bottom of the wound give rise to fistulous tracts, until they are entirely removed. In this case, twice as long a time may be necessary to a cure. The pain and intensity of the lameness after the operation do not accurately indicate the nature of the disease; the general phlogosis, especially the synovial inflammation, always causes a special acute pain, which for from three to six weeks may prevent the animal from resting his foot on the ground. This pain is entirely independent of the process of repair, and must not alarm the veterinarian. While the reacting fever is absent, and there is a good appetite and no swelling in the region of the coronet, the progress may be considered satisfactory.

After the cicatrization of the plantar wound made during the operation, the parts may return to their physiological condition, or nearly so; or, on the contrary, remain in an entirely abnormal condition. Often, indeed, the sesamoid sheath may become obliterated, the diarthrodial surface has lost its smoothness and there is no more sliding upon it, the tendon having become united to it. The animal then remains lame, and cannot be utilized except in walking; if coronary anchylosis, ringbones are detected, and the application of firing is indicated. Sometimes neurotomy gives excellent results.

Contracted Heels—Hoof Bound.

Synonym: *Zwanghuff*, German; *Encasleture*, French; *Incastellatura*, Italian; *Encatenadura*, Spanish.

This name has been given to a defect of the horse's foot, by which it becomes characterized by its general narrowness, more marked, however, in the posterior than the anterior part. It is especially marked by the diminution of the lateral diameter of the horny box, the deformity consisting in a greater or less contraction of the heels and of the quarters.

It is principally observed in the fore feet, and it is there only that it presents the characters we are about to describe. This is due to the fact that in the fore legs there is need of a certain expansibility in the posterior part of the foot, which, especially during the action of locomotion, receives the weight of the body; while the contraction of the hind feet gives rise only to an ordinary form of lameness. Sometimes one of the anterior legs only is affected; sometimes both, and in this latter case the alteration is usually greater in one foot than in the other.

Some horses are also seen whose feet are contracted only on one, usually the inner side, while the other preserves its normal form and directions.

Sometimes "hoof-bound" is only a simple deformity, without lameness and without serious result. But in most cases, it constitutes a very serious affection, which renders many horses useless and almost without value. It is of more common occurrence than is generally admitted, and gives rise to many other affections of the foot. Cases of lameness treated as located in the shoulder, or as navicular disease, are very often nothing but the result of commencing contraction of the heels. True navicular arthritis and hoof-bound are closely related. Whether the disease of the sesamoid sheath, arising primitively, brings on the subsequent contraction; whether the contraction already existing gives rise to the alteration of structure which constitutes the disease so named, cannot always be determined. Hoof-bound was known in old times, and the oldest hippiatrics have proposed means to cure it. Riders especially have studied it, because the disease is most common in fine saddle horses, whose feet are small. It is frequent in Turkish and Spanish horses, and animals from the Pyrenean districts, but common horses are not exempt from it.

H. Bouley describes two forms of the disease, the *true* and the *pretended* or *false* contraction. In the first, the hoof is very narrow, sometimes even concave on its lateral face, to such an extent that its antero-posterior considerably exceeds its tranverse diameter; while at the same time its wall is more vertical, and the heels considerably higher than normal, and the foot looks like that of a mule, of which this is recognized as the normal appearance. In the false contraction, there is merely a diminution of the transversal diameter of the horny box in its posterior parts, the foot being narrow and contracted at the heels only.

We prefer to recognize a *total* contraction where the whole foot is contracted, and is smaller than its fellow, *atrophied*, so to speak, consisting in a contraction *of the quarter*—when it is principally narrow in those quarters, the condition extending back to the heels—and a contraction *of the heels* when this is well marked from the quarters to the heels only. A *coronary* and a *plantar* contraction have also been designated, depending upon whether it occurs at the superior or inferior part of the foot, and there are cases where the contraction is *intermediate*, that is, in the middle of the foot only, while it has its normal size, both at the coronary band and at the plantar border. *Single* and *complicated* contractions have also been named. It is admitted that it may be *congenital*, though rare; more often, however, it is developed by itself, as a result of special causes.

I. *Symptoms.*—The physiognominal aspect of the hoof-bound foot is characteristic, and it is by this that we shall begin the symptomatology of the disease. When the disease is total, the complete general dimensions of the foot are observed to be smaller than would be required by the size of the animal affected; most frequently the hoof has an oval form, consequent upon the antero-posterior diameter exceeding the lateral, which is generally diminished. In the contraction of the quarters, the narrow condition of the foot is specially marked from the centre of the quarters back to the heel. In contraction of the heels, the diminution is very marked from the centre of the quarters to the end of the heels, so that the two sides of the wall converge toward each other posteriorly in following nearly a straight line, instead of the circular appearance of the normal state, and the heels have principally lost their round appearance, and are elongated, and even pointed in appearance. The wall, in the regions where the con-

traction is more marked, that is, behind, is either perpendicular to the ground, or even oblique downward and inward, in such a way that the coronary circumference is greater than the plantar, and consequently it represents an inverted truncated cone.

The opposite form of contraction, that of the coronary, is seldom seen, and we may ignore it. The wall is irregularly rough and ramy, and without its shining appearance. The heels are generally high, nearly as high as the toe, though it is not so severely altered in cases where the heels only are contracted. As a consequence of the contraction of the plantar border of the wall, the sole seems to become folded in the direction of its antero-posterior axis, and it shows a much greater concavity on its internal face than in the normal state. This cavity is then filled by the frog, considerably reduced in size, thus presenting an idea of the severity of the contraction. Most frequently it is a thin, thready body, flattened on its sides by the closing of the bars; its branches, thin and narrow, resembling two bands so closely resting on each other that the lacunæ which separates them is no more than a narrow fissure, which will scarcely admit the introduction of the thin blade of a knife, and from the bottom of which escapes a sero-purulent, gray or blackish liquid; the lateral lacunæ being also transformed into two narrow and deep fissures, filled with the same fluid. The bars, generally high, assume a direction perpendicular to the ground, instead of being oblique, as in the normal state, from the centre of the foot toward its circumference.

In all the regions of the foot, but especially at the wall, the horn is so dry and hard that sharp instruments cannot cut its cortical covering, while it is at the same time brittle, and hence numerous superficial fissures appear at the quarters, and the outside and inside toes, the frog itself being hollowed by fissures upon its body and branches. Sometimes it happens that the bars show deep fissures, running from above downward, to the extremity of the lateral lacunæ, which are thus continued by a crack of the heel up to the skin of the coronary band. There is often a separation of the wall and the sole, the formation of what has been called a double wall, or false quarter. Quarter cracks are commonly met with it. Corns are frequently seen in connection with it.

Whatever may be the form of the contraction, it is generally accompanied by pain, manifested by change of position while at rest and by lameness when in action.

If only on one side, the affected leg is carried forward, and thus relieved from the too painful pressure which would take place if it remained in a vertical direction under the center of gravity. When both feet are diseased, the horse is constantly moving and balancing himself, pointing the legs alternately, and sometimes stretching both legs forward, as in laminitis, but always moving, so as to push his bedding under him and away from his fore feet.

If the pain is slight, there is only a stiff gait, and the animal hesitates and stumbles easily. But if the disease is advanced the lameness is great and the animal is very groggy in his gait. He fears to rest on his heels, which, without being a peculiar characteristic, is a symptom which present, however, a particularly noticeable condition. While there is hesitation in the action of resting, there is difficulty in that of the shoulder. This is principally observable when the disease affects both feet. The shoulders then seem to be fixed to the trunk, and their motion forward is very limited. The symptoms are mostly more marked when the animal leaves the stable. It may then happen that the pain temporarily losing somewhat of its intensity as the horse is moved, the shoulders become more free, the liberty of action returns, and once warmed up, the animal may offer a totally different appearance from that when first leaving the stable. But as soon as they become rested, the pain returns as severely as before, if not more so, and with it the same exhibitions of symptoms.

The examination of the unshod foot while it is warm, shows the extreme sensiblity of the heels. The foot being pared, generally one may observe, in the region where the contraction is most marked, yellowish or reddish discolorations, evidences of the bruises in the living parts, as well as of the serous or bloody exudations which have taken place on their surfaces. These indications are especially abundant on the level of the sole and wall. If the contraction is old, there is at that point a purulent mass which, when removed, leaves a cavity which sometimes extends upward under the quarters. It is a separation of the wall, of two or three centimeters in depth.

An important observation for hoof-bound, and which assists in its recognition, is the increased wear upon the shoes at the toe, which takes place not only when animals are working, but also while idle in the stable, as the result of pointing and scraping the

stable floor. The horse which has both feet diseased in constantly in motion, to such an extent that his shoes are entirely worn in a few days.

At times the pain is so great that it gives rise to general symptoms; the animal becomes anxious, loses his appetite, refuses his food, lies down most of the time, and rises only with difficulty.

II. *Complications.*—We have already seen that *quarter cracks* and *dry corns* are common affections of contracted feet. Exostosis of the phalangeal region is also commonly met in such feet, especially side-bones. Knuckling, and diseases of the tendons and of their sheaths are also often caused by contractions of the feet. The rest of the foot on its whole surface is thus perverted and the tendons become retracted, painful and swollen.

Navicular disease is so often met with in company with contracted feet, that one disease is frequently mistaken for the other.

Laminitis has been said to be also one of the complications; if so, it is at least quite rare in its occurrence.

Tetanus has sometimes been observed among its associations, and Hartmann attributes the development of so-called idiopathic cases of that disease to this condition of the feet.

The emaciation of the affected leg is a complication seen also, with other forms of lameness.

III. *Pathological Anatomy.*—We have indicated the external changes of the hoof. The tissues that have been long enclosed in the contracted foot become atrophied; molecular changes do not take place as in the normal state; they become changed in aspect, composition and properties; they become denser and more compact, and are no more able to fulfill, to the same extent, their physiological functions.

The plantar cushion is so completely pressed upon itself that the stratified structure of its fibrous layers can scarcely be distinguished, and the presence in the interstices of the yellow fibrous substance is with difficulty observed. It forms only a homogeneous mass, whitish in color, resisting in consistency, and lardaceous in aspect The dilated bulbs which are above the cushion are also considerably diminished in size, and present, when cut through, a uniform white color, its composing substance being reduced to a single inelastic mass.

The ungueal phalanx becomes deformed by degrees, loses its circular shape and becomes of an elongated oval form. Its lateral

faces assume a perpendicular direction; its structure is modified; its substance becomes more compact, and the small vascular openings are obliterated, while the largest are increased in size. The work of obliteration is specially observable at the patilobe eminences, which appear to be crushed. The lateral cartilages are also much compressed, condensed and modified in their structure.

The navicular bone is also compressed, the sheath and its support not allowing the easy play of the tendons, and it is in this way that navicular disease may follow hoof-bound. But there is a specially noticeable modification in the keratogenous apparatus, which, as a consequence of the arterial obliterations, fails to receive freely and actively the necessary amount of blood. The horny secretion proper to the podophyllous tissue, the white or soft horn, is reduced; the podophyllous tissue itself is atrophied; its lamellæ are less prominent and their separations are diminished in depth; the adherence of the podophyllous or kerapyllous tissues still exists where the circulation of the blood is not interrupted, but beyond, they are easily separated and often present deep excavations toward the sole.

If hoof-bound advances slowly, the same atrophy of the subhorny tissues takes place. Then, however, it proceeds by degrees, the tissues accommodating themselves in size to the gradually diminishing dimensions of the cavity where they are contained, and there is an equal proportion between the size of the hoof and the volume of the tissues enclosed in it. These being less compressed, there is less pain. In this manner an excessive contraction of the heels may sometimes exist without marked lameness.

IV. *Prognosis.*—This is the more serious as the disease is more developed. Total hoof-bound if excessively tenacious, and resists the best curative measures, though if there is only a slight contraction at the heels, it is generally amenable to judicious treatment. The duration of the disease is an important factor in the question of the success of the treatment, as the condition of the os coronæ, os pedis, navicular bone, sesamoid sheath, plantar cushion and the atrophy of the keratogenous membranes have all to be taken into consideration.

The age of the diseased animal and any existing complications are, of course, circumstances which influence the prognosis in an important degree.

V. *Etiology.*—Hoof-bound, says H. Bouley, is not a simple fact, produced by a unique cause acting always in the same manner: it is, on the contrary, a very complex one, to the production of which a great number of causes of various character and intensity contribute with simultaneous or successive effects.

The hygrometic condition of the horny substance is a principal feature in the etiology of the disease. It is when the hoof loses by evaporation the moisture which it should contain that it contracts as all organic substances do, and its flexibility returns when by sufficiently long immersion in a liquid, the moisture it has lost is recovered. Observation proves that this disease often finds the conditions of its presence in circumstances which induce dryness in the part. In such cases the foot has the property of retracting, to an extreme degree, especially toward its posterior extremity, where the frog is situated, constituted as it is of a softer and more depressible substance than that of the wall. The same phenomena takes place in the living structure that is observed upon the hoofs of dead feet; a phenomenon which cannot even be prevented by filling their cavity with plaster. During life the hoof is constantly permeated by a current of fluids which penetrate it from its depth to the surface. It is the serous food that the hoof is continually absorbing by the hygroscopic properties common in living tissues, which counterbalance the tendency of the foot to retract upon itself and keep it in the dimensions required for the perfect reception of the parts it covers. So long as the equilibrium is preserved between the loss of this fluid by evaporation and its renewal through the perspiration of the keratogenous apparatus, the hoof preserves its physiological form; but if this equilibrium is destroyed by an excess of the loss, then the condition occurs for the retraction of the hoof and the infliction upon the parts underneath of an excessive and painful pressure.

This explains why, as proved by observation, lameness in general and that of contracted heels especially, is more frequent in warm than in moist seasons. Long standing in the stable is also an efficient producing cause. The feet become dry upon a constantly dry bedding, and here also the influence of inaction must be taken into account. The disease is commonly found in stabulation, but seldom when the animal is in pasture; and when it has existed it often disappears in the latter circumstances.

The alternation of dampness and dryness also influences per-

haps more the genesis of the disease than dryness alone. A foot too much impregnated with dampness, which is afterward left to the air, becomes harder than a normal one placed in the same conditions. It retracts easier, also. It is probable that the water, in softening the superficial layers of the wall, also renders the evaporation of the liquids of its deep parts more active. In the ordinary condition of the foot, the evaporation is diminished by the impermeability of the external hoof, which it owes to its density; but where this hoof is softened by maceration, its fibres, partly disintegrated by the dissolution of the glutinous substance which keeps them as a compact mass, allow the air to penetrate in their interspaces; air which dries them to a certain depth; hence a groportionate movement of retraction of the entire hoof upon itself. This evil effect of an excess of moisture explains how it is that poultices or other moist applications which horse attendants abuse so frequently, may give rise to results entirely opposite to the one in view, and why the hoof becomes dry and brittle, if not contracted. These topical applications take off from the cortical layer of the foot its protecting varnish, and expose it to lose its water of growth.

Some of the practices in shoeing contribute also to the dessication of the hoof; such is principally that which consists in rasping the wall from the coronary band to the plantar border; as also the too long continued contact of a hot shoe with the foot.

Shoeing itself promotes the same result, as, protected by a shoe, the foot no longer wears normally and grows beyond normal limits. The mass of hoof which, in the process of growth, has gone beyond the inferior limits of the podophyllous fissures, is no longer in contact with the living parts beneath, and they cease to be impregnated by the fluids which are thus constantly allowed to evaporate. It then dries up by evaporation and become hard, and retracts upon itself in such a manner that the circumference of the foot in the lateral diameter diminishes more or less, especially posteriorly, and thus forces the incurvations of the sole and of the bars (H. Bouley). If a horse remains shod for several months without having his feet trimmed and pared by the blacksmith, these are seen contracting by degrees, as they increase in length, and soon assume the aspect of hoof-bound.

But these are not the only effects of shoeing in the etiology of contraction. On the contrary, this practice is the most common

cause of this lesion of the hoof if not practiced with the intelligence it requires. We have said, in speaking of corns, that they were proofs of bad shoeing. The same might be said of the contraction. Moreover, corns generally indicate great errors in shoeing, while hoof-bound demonstrates the ignorance of the physiology of the hoof, which in action must enjoy the necessary elasticity to relieve the contact with the weight of the body upon the ground. No doubt the theory of Bracy Clark exaggerates the degree of elasticity in admitting a great power of dilatation of the hoof, but it is an opposite excess to deny it entirely. The dilatation of the hoof, though limited, is evident at the heels; especially on feet which have never been shod (Merche). There is especially in the inside of the foot, in the soft and supple parts, a certain compressibility of the hoof, which is often overlooked, and which is interfered with by a too narrow or unmethodical shoeing.

The external dilatation of the hoof is comparatively limited, but on the inside of the hoof there is, in the posterior part of the foot (especially in the fore feet) a movement downward and outward of the os pedis, for whether the normal elasticity of the hoof is necessary, either by the physical and physiological constitution or the arrangement of the constituent parts of the hoof. Quite often, then, shoeing, especially if too tight, resists the internal pressure. Even admitting that the dilatation of the heel is normal, shoeing which would prevent it, would always produce, at the time of rest, a pressure upon the hoof which would limit the compressibility of the deep, soft tissues. The frog, especially, formed of a softer horn, and placed under the plantar cushion, must receive this gradual pressure, which diminishes by degrees as the hoof becomes harder, and is reduced considerably as it reaches the external horny layers.

The errors committed in shoeing, and which predispose to hoof-bound, vary. The first is in the manner in which the foot is pared; too often the heels are lowered to excess, while the toe is allowed to remain too long; too often, again, the bars are hollowed too deeply, thinned too much, as well as the frog. The wall then tends to retreat, as it is no longer protected behind. In reducing the height of the heels, in opening them, the tendency to contraction is increased; the thinned hoof dries up, the lowered heels lose their strength, and the bars are unable to perform their functions.

A vicious adjustment also contributes to contraction. When the shoe is so prepared that its upper face is concave, and its branches form a plane inclined from without inward, and when this face extends back to the heels, there is a circular pressure produced upon the inferior border of the wall. This is a case in which the foot has a tendency to drop, pressed in as it also is by the weight of the body as the foot rests on the ground.

Another wrong practice is to place the nails too near the heels. The fixing of the shoe on the foot tends always to produce contraction, as Bracy Clark observed; it especially prevents the widening of the hoof, as remarked by Rodet and Coleman. But this effect of the nails is well marked at the heels, where they prevent the dilatation of that part of the foot.

These effects of shoeing are to be observed so much the more rapidly and seriously when the hoof is thicker, denser, and of a finer structure, as it is observed in small feet. In these feet, the hoof grows more rapidly, and is on this account more ready to contract. Let us now consider that this effect of shoeing is permanent, and that to the effect of a first shoeing comes to be added that of a second, of a third, and so on, and we can readily understand how truly the great number of contracted heels one may meet with can be attributed to erroneous shoeing.

Inaction is also an important cause, as, says Turner, the horse is by nature destined to be always in motion; it is a condition of its health, and it is on account of this condition that in the state of nature he is free from contracted heels. It is, on the contrary, because the domesticated horse is confined within a stall for hours and days, that his feet become contracted. We have seen colts raised without exercise, whose feet were contracted before they were shod.

Contraction of the heels is often the result of other diseases of the hoof, and of other lameness. It is commonly associated with corns, navicular disease, punctured wounds of the plantar region, accompanied with long sensitiveness of the posterior parts of the foot, after-diseases of the frog, thrushes, side bones, phalangeal articular diseases; in fact, after all affections of long standing, even if they have their seat in the upper segment of the frog.

Finally, heredity has been named as one of the causes. This cannot be denied as to some breeds, principally of meridional climates, as a consequence of the organization of their feet, which

are usually small. The proposition has, however, we believe, been exaggerated. This is proved by the Arabian horse, which, though accused of the vicious confirmation from heredity, has, according to Vallon, Crompton, and others, the most admirable comformation of his feet, when it has not been shod. It is broad, with good heels, neither too high nor too low, well open, well prominent, wide frog, the external wall being strong and well developed. In the horses of Caramania, Anatolia, Syria, and those of the Arabs, which are constantly in the desert, from Bagdad and Bassaro to the Gulf of Persia, the foot is handsomely made, and free from all contractions when it has been exempted from shoeing.

VI. *Treatment.*—Prophylaxy plays an important part in the treatment of this disease. It is easier and especially more rational, to prevent than to cure it when once established.

One of the first indications is to prevent the drying of the hoof, to effect which baths and poultices have been commonly used—the latter formed of cow manure, of clay, etc.—or by the application of greasy substances, in order to diminish the evaporation of the water of the hoof. Some practitioners are accustomed to use tar and various hoof ointments. The number of preparations brought into use is considerable, and in respect to some of these, the secret of which has been kept by the inventors, the effects have been entirely different, and the hoof, instead of preserving its natural good condition, has been altered in its qualities. "It is not with ointment," says Hartman, "that the hoof injured by the blacksmith can be repaired. It is by good shoeing, and never otherwise. The workman, to excuse himself, attributes to the quality of the hoof the origin of the mischief he has done." Hoof ointment never gives to the hoof its natural polish, but many ointments, by becoming rancid, take off that which the blacksmith has left. The irritating ingredients which compose them sometimes produce the same results. This does not mean that a reasonable application of ointment is not necessary; but to act favorably it is essential that one coat should be carefully removed before the application of another. Otherwise, the new will fail of its proper effect, and, on the contrary, the old coat, by its alteration, will give rise to a deterioration of the hoof, especially in affecting the substance which unites the horny elements, and would reduce it to fine powder. And, again, ordinarily it is only the wall which

is greased, the hoof of the sole and of the frog being left without, though they may be in equal need of it. The best hoof ointment is made of lard, a small quantity of wax or turpentine, sometimes mixed with tar. Glycerine is very useful, to give the hoof suppleness when it has become hard; it is applied by friction, after the foot has been well washed and dried. In the majority of cases poultices are preferable to mucilaginous baths.

Greasing is necessary for horses which are much exposed to dampness, and is as good for the sole and frog, as for the wall. It is applicable, also, to feet which have to stand on dry bedding. Feet, which, on account of diseased conditions, require to be frequently soaked or poulticed, ought also to be greased. Bedding of fine sand and of sawdust has been recommended. It is well, also, to place horses upon marshy lands. All these measures may be advantageous if the feet are properly shod.

Good shoeing is the essential prophylaxy of hoof-bound; we must avoid all improper practices likely to promote desiccation and contraction of the foot, such as abuse of the rasp; too long application of the heated shoe when fitting it to the foot; the lowering of the heels; the excessive paring of the frog or of the bars; the bad fitting of the shoe; useless calks; too many nails in the quarter or near the heels—all these errors must be carefully avoided. The foot, moreover, must not be allowed to grow too long. The shoeing should be renewed at least monthly, even if the shoe is not worn. And lastly, the horse must not be allowed too long periods of inactivity.

It has been proposed to abolish the custom of shoeing, but in the present conditions and modes of using the horse this is impossible. The feet, deprived of their accustomed protection, would soon become painful, and only by keeping the animal in the country could the feet be suffered to remain unshod.

Several modes of shoeing have been invented to prevent contractions in feet which are predisposed to them. Some are undoubtedly beneficial, but they must be used as an ordinary shoeing, and not reserved until the access of the disease. Good ordinary shoeing is often all that is required, but no doubt better and quicker results will be obtained by the shoe with short branches, with the flat shoe, or with the Charlier shoe.

The *half shoe, the shoe with short branches* (*fer a croissant*), originally recommended by Cesar Fiaschi, then by Solleysel, La-

FIG. 498.—Short-branched Shoe.

fosse, Sr., and Crompton, is an ordinary shoe, made light, with very short branches (Figure 498), which when put on protects the toe, the mammæ (outside or inside toe), and the anterior parts of the quarter in such a manner that the parts posterior to these remain uncovered, and rest directly on the ground. Thus shod, the shoe is almost in its natural condition; it rests on the ground by its posterior part, and the heels are made to contribute to the movement of expansion of the elastic parts of the foot. This shoe, then, has real advantages, if the posterior part of the foot is yet normal, but if the heels are low and the frog atrophied, it ceases to be of service.

The *flat shoe, or the shoe with base* (*fer a siege*), first recommended by Osmer, Morcroft, and more recently by Miles, Einsiedel and Hartmann, is the style generally adopted at the present time in Saxony, and in various parts of Germany, as well as in England. In France it has found its way through the benefits observed by a few veterinarians. It is a shoe almost equal in thickness to its width, square, so to speak, but as light as possible; the internal border of the foot surface being hollowed or dished in order not to come in contact with the sole, while the part which rests on the plantar border of the wall is perfectly flat and horizontal. The heel portion is rounded, and covers mostly the heels of the foot where the borders of the shoe become perfectly adapted to the borders of the wall, to the remotest part of the heels, and preserves the same contour until it reaches the frog. The shoe nowhere projects beyond the border of the wall; it is only toward the toe that it is slightly raised and has a small clip. The groove of the English shoe renders its application better than the peculiar nail holes of the French. Five or six nails are usually sufficient. This shoe allows the dilatation of the foot in

all its limits, and while protecting the heels, does not predispose to their contraction. For its application, the plantar border only needs paring. That of the sole, the frog and the bars must be carefully avoided.

For the *shoeing of Charlier*, or *peri-plantar* (Figs. 499 and 500) the part of the hoof which is most exposed is protected. It

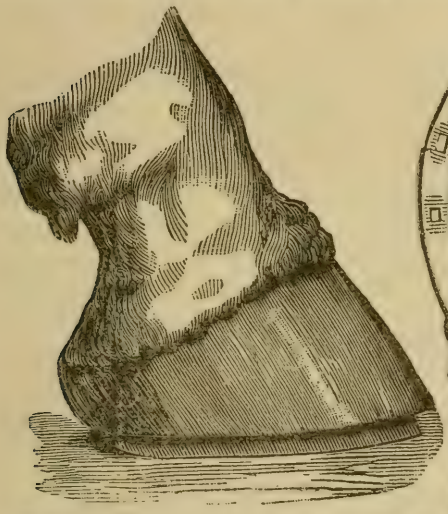


FIG. 499.—Foot prepared for Charlier Shoe.

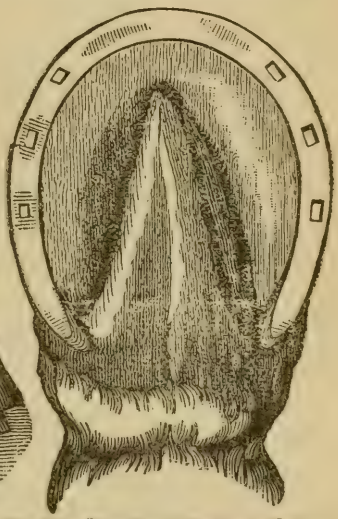


FIG. 500.—Foot Shod; Charlier's Method.

preserves entirely all the other parts of the plantar surface in such a way that, as in the conditions of nature, it is only by the fact of the wearing of the shoe that the excess of hoof is gradually removed. The foot shod by this process is provided at its inferior border with a metallic bar, often greater in thickness than in width, lodged in a groove made exclusively in the wall. This bar adapts itself in its internal circumference to the contour of the sole, which projects beyond the border of the groove, because all its thickness has been preserved as well as that of the frog and of the bars. In this way the rest of the foot receives its adjustment from the shoe itself, and by the regions of the plantar surface which it surrounds. This result does not, however, take place immediately, or when the foot is recently shod; but by degrees, and as the shoe wears out, the time arrives when the horse walks both on his shoe and the sole of his foot. Owing to the general equalization of the friction any partial wear is thus diminished,

and the important result is secured of reducing the weight of the shoe without the necessity of too frequent renewals, experience having proved that for the fore-feet it is quite as durable as the ordinary shoe of twice its weight, but which from the manner in which it is applied suffers, unaided, the effects of the pressure and friction (H. Bouley). As in the action of paring the foot only the projecting portions of the wall at the inferior border are removed, the preserved parts of the plantar region resist the movement of retraction, and thus prevent its occurrence in a transverse direction. Again, as the thickness of the Charlier shoe is greater than its width, it possesses a certain elasticity and adapts itself to the successive movements of the dilatation and contraction of the horny box, however limited they may be.

We may now refer to some special modes of shoeing, recommended as preventive of contracted heels, but which seem to us to possess inferior advantage to the preceding. We first find the *unilateral shoe* of Turner, which, according to that veterinarian, relieves the foot from pressure upon the heels by placing the nail holes on the toe and the external branch only. Turner recommends also the conservation of the frog and that of the bars, and it is probably to this that the success he has obtained by that mode of shoeing is due.

Coleman recommended a shoe very thick at the toe and thin at the heels, the toe being three times as thick as the heels. This veterinarian thought that by this shoe the animal was obliged to rest on his frog; at the same time the nails were driven in the toe principally, so as to allow the dilatation of the heels. This shoe has no real advantages, and predisposes to corns.

The *bar shoe* is of some utility when the frog is well developed, by placing on that part the pressure of the foot, and leaving the heels free. But it often fails in contracted heels, because in applying it these parts require to be pared down, in order to increase the prominence of the frog, and a condition is thus produced which does not exist in contracted feet. The same may be said of the *Charlier bar shoe.* The objections stated and the reasons suggested are true of all the various shoes designed to adjust the frog pressure.

The *hinge-shoe* or *articulated* (Figs. 501 and 502) of Bracy Clark and Vatel, and the *half-shoe* of Sempastous, of Peillard, also possess but a doubtful utility. Practice has not confirmed

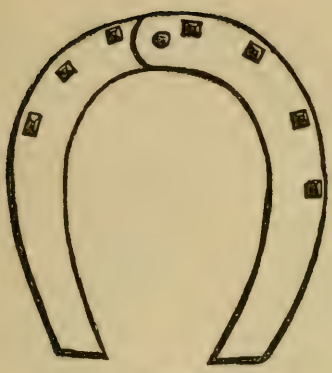


FIG. 502.—Hinged Shoe.

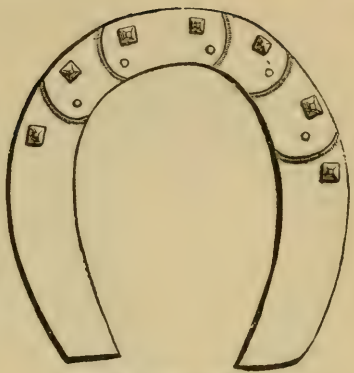


FIG. 502.—Articulated Shoe.

the hopes of their inventors. They are difficult to make, easily injured, and of small solidity, and their advantages are wholly of the problematic order.

Mayer has recommended a shoe whose internal border is thicker than the external, in such a way that the plane of the plantar surface of the shoe shall be inclined outward, and instead of the concavity of the ordinary shoe, where the foot is pressed when in position of rest, there is a convexity which promotes and even increases the dilatation of the foot. This mode of shoeing has for its inconvenience the exposure of the sole to contusions. It supposes an extensive expansion of the foot which is not natural; the horizontal plane is amply sufficient in ordinary circumstances. We have, however, used it advantageously in preventing the pressure of the sole against the shoe by means of a sheet of gutta-percha. We have used it in almost complete contraction, and we think we have noticed, with Hartmann, that the dilatation once started by a mechanical means, not too severely applied, nature continues it, with the assistance of that style of shoe. Instead of giving that special shape of the shoe in its entire length, it has been proposed to have it only at the branches; each heel presenting at its internal border a thickness double, or even treble, that of the external, by which the shoe is inclined outward by its plantar and becomes horizontal by the ground face. It is flat at the toe and the quarters, and is the shoe with *slippers* of de la Broue (Fig. 503), of Solleysel, and that Vatrin has used in proposing to have the internal half of the width of the shoe inclined (Fig. 504). It thus resembles the shoe *geneté* or *with ears*, of

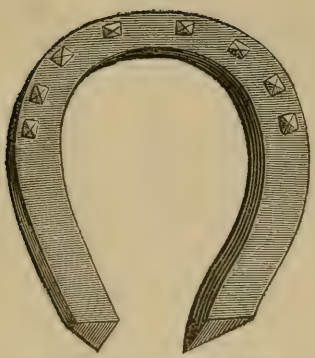


FIG. 503.—Shoe of de la Broue.

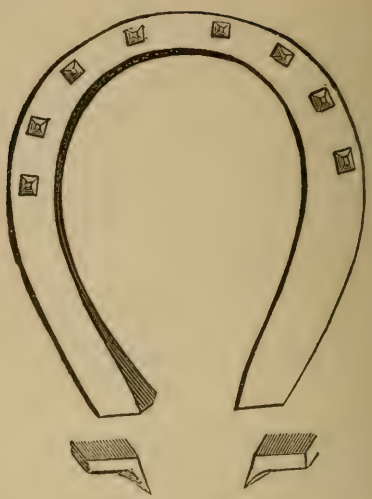


FIG. 504.—Vatrin's Shoe.

which we shall speak hereafter. This shoe is only indicated when the heels are already contracted; they have no indication as prophylastic shoeing.

The shoe with slippers is indeed a shoe which in some cases may cure contraction. "If the results obtained have not been very satisfactory," says Defays, "this depends not upon the shoe, but arises from the defective manner in which the foot was pared. To be efficacious in that shoeing the heels must be left alone, and the sole and the bars must be well thinned. It is true that in this way the foot is in the most favorable condition for contraction, but the circulation is rendered easier in the tissues underneath, and the effects of the thinning of the hoof are diminished by the resistance opposed to contraction by the inclined planes of the branches of the slipper. The same may be said of the shoe of de Belleville, also recommended by Solleysel, and for whose applications the foot has to be carefully pared. We feel assured of the propriety of recommending the use of the inclined plane of the branches of the shoe with the presence of a small clip on the inner borders of the heels, such as proposed by Vatrin.

Attempts have been made to dilate the contracted foot and to cause its return to its normal dimensions by mechanical means. The *shoe with ears* (Fig. 505) has been devised for this purpose. This is a shoe provided on the inner border of each heel with

an oblique, blunt, sometimes perpendicular *clip*, resting upon the bars, which have been previously hollowed out for its reception, the design of which is to resist the return of the hoof which has been dilated, to its former contracted condition. Ruinien had spoken of this shoe as early as 1618. It was put on, after the dilatation of the hoof with the farrier's nippers, applied on each

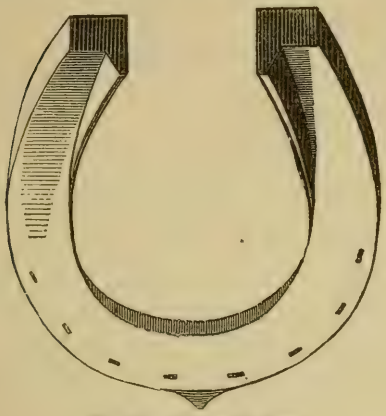


Fig. 505.—Shoe with Ears.

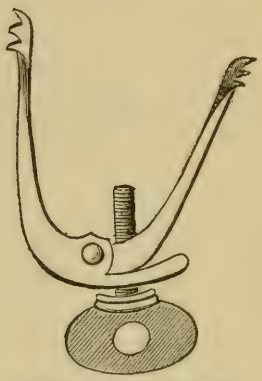


Fig. 506.—Jarrier Spreader.

side of the quarter, the sole being entirely removed. In our days this operation of removing the sole is considered useless, and instead of the nippers of the farrier, dilators are used, under the name of *spreaders* (desencasteleur). The oldest known form is that of Jarrier (Fig. 506). This is composed of two curved branches, 11 centimetres in length, articulated at one of their extremities like the ordinary compass, at which point there is a screw of peculiar form by which the branches are closed or opened at will, the other extremity having a strong claw projecting outward. These claws are applied inside of the bars, toward the heels, which are previously thinned out, and by manipulating the screw the hoof is dilated to the extent desired. The shoe is then used like an ordinary one, both heels being armed with a clip on the internal border, the clips resting on the heels of the foot, which have been first opened with the drawing knife. This mode of treatment proved successful with Lafosse and others who experimented with it at the Saumur school. Under various experiments, the *desencasteleur* has changed its form. Thus, Lafosse has arranged the two branches to run separately upon a transversal

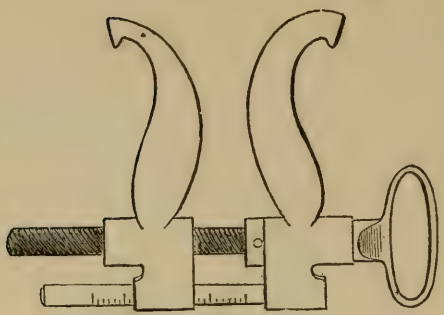


FIG. 507.—Lafosse Desencasteleur.

rod like an ordinary vice, in which form the branches are shorter, and more power is obtained (Fig. 507). There are many other improvements which we cannot mention for lack of space.

Instead of applying the dilatation upon the hoof, and afterward using a shoe which is closely adapted to the dilatation thus obtained, spreading shoes have been used. In the method of Jarrier, the shoe has to maintain the hoof in the condition of dilatation which has been accomplished by the instruments of expansion. It is a very delicate and difficult operation, so far as the proper dilatation of the foot is concerned, requiring the closest adaptation between the clips of the shoe and the parts of the wall upon which they rest. An error of a few millimetres only is sufficient to defeat the desired result; and the shoe, moreover, must be taken off at each operation. To avoid this, special shoes, which would act also as dilators, were invented. It was not, however, a new idea; La Gueriniere had as early as 1733 prepared a shoe composed of three pieces—one median, corresponding to the toe, and two laterals, in connection with the quarters; these latter are respectively articulated with the first, and have each three nail-holes. When this shoe was fixed upon a foot, whether unsoled or not, its branches were spread apart by a plate left in place, and by increasing by degrees the length of the plate, a gradual and increasing dilatation of the hoof was obtained. Gaspard Saunier improved upon this shoe by placing on the internal border of the branches, cranks, with a plate placed crosswise and resting upon them (Figs. 508 and 508*a*). The objection to this shoe is that it cannot remain on the foot except when the animal is at rest, as when he is at work it soon becomes loosened; besides which it is difficult to make properly.

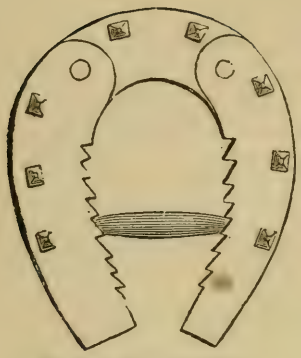


FIG. 508.—Spreading Shoe.

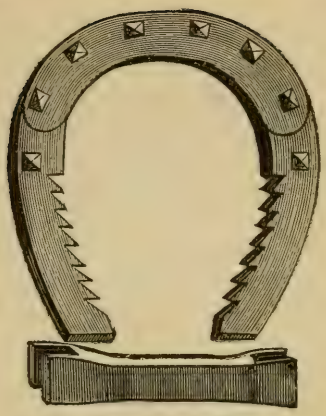


FIG. 508*a*.—A Better Form.

Rolland has contrived an articulated shoe in three pieces, the two lateral pieces being kept apart by double steel springs, which press upon them from the toe on their internal border, and thus effect the desired dilatation. Hatin has a simpler shoe (Fig. 509). It is a light shoe, with nail-holes distant from the heels, and provided on the internal border with a small clip, upon which rests a V spring, fixed by its point upon the toe of the shoe. The branches of the spring lodge in the hollows of the sole and of the frog, and press upon the shoe, and thus produce a slow dilatation. Steinhoff has also invented a shoe with springs. It has recently been proposed to obtain the dilatation by means of a strong sole of cautchouc, placed between the shoe and the foot, leaving the frog full; very thin where it rests upon the shoe and the foot, and becoming thicker toward the inner border of the shoe, which it overlaps. First it rests in the groove of the bars, and then portrudes upon the flat of the shoe, and bears on the ground at the time of rest. This elastic mass, compressed at the moment of contact, slightly dilates the shoe, which is articulated, or, what is better, very narrow at the toe, and square; the heels, also, are thus slowly and gradually dilated.

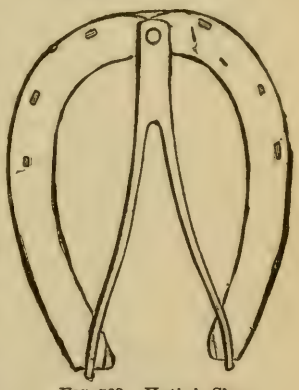


FIG 509.—Hatin's Shoe.

Goodwin also has invented a very ingenious, but too complicated shoe, composed of three articulated pieces. From the center of the median piece a prolongation of iron extends to the back of the frog, and is of sufficient thickness to be perforated, the hole having a thread through which a screw is introduced, running on each side. The branches of the shoe have three nail-holes, and from the inner border of the heel rises a clip so turned as to rest on the origin of the bar. The mechanism of the shoe is easy to understand, each branch being opened by the play of the screw which passes through the prolongation of the median piece, one extremity of which rests upon this prolongation, while the other presses upon the inner border of the movable branch.

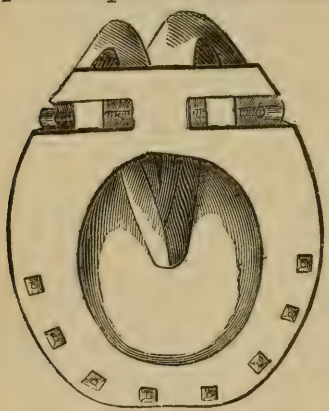


FIG. 510.—Foures' Shoe.

The Goodwin shoe has been essentially improved by Foures (Fig. 510). It is a bar shoe, the bar being thicker than the rest of the shoe, and wider than the ordinary bar shoe. The bar is notched on each side, and through each notch runs a thread or vise which holds a movable clip, which is made to rest on the inside of the bars, and which are first properly thinned out. By a motion of the clip through the thread, the heels are slowly dilated by degree. This shoe, however, is very expensive, difficult to make, and easily put out of order.

In all these methods of dilatation the shoe has to be made of several pieces, and in this condition is found a constant cause of weakness and of rapid deterioration, for which reason they are not very practicable. It is not so with the system used by Defays, Sr., by which the shoe, besides containing the essential elements of the desired mechanical dilatation, is left entire to fulfill the functions of the ordinary shoe, as well. That which characterizes Defays' method, who had used it in 1829, but which was made known only in later years, is that the shoe itself, which, by its ductility in action, becomes the agent of the dilatation of the hoof, becomes also, by its natural tenacity, the obstacle to the return of the foot to its former contracted condition, when once it has yielded to the outward motion which it has acquired. De-

fays uses an ordinary shoe, thick and narrow, and then further narrowed at the toe, if it is to be used on a foot regularly contracted. When it is thus affected, at five or six centimetres of the heels if the contraction exists at the quarters, at the end of each branch. This shoe carries on the inside border a strong, resisting clip, made at right angles, to rest on the internal border of the wall of the heels. The shoe is flat, grooved, like an English shoe, with nail-holes slightly turned inward; the last nail-hole made as far as possible from the heels. It is made of the best quality of iron, in order to resist, when cold, the greatest amount of forced spreading by the dilator; it is the *expansive slipper* of Defay's (*pantoufle expansive*).

The foot upon which this slipper is to be fixed must have both heels pared evenly, the sole and the bars pared down to a spring, and the hoof round the frog, on each side, thinned down as much as can be borne. Then, the shoe, flattened and without curvature on its faces—resting, therefore, on a strictly horizontal plane—is put on the foot in such a manner that the clip of the heels rests against the internal face of the quarters. This done, the space between the two heels is measured with a compass, and then the dilator is applied (Fig. 511). This instrument represents a true vice, with jaws reversed, moving from, instead of approaching each other. It is formed of two jaws which can be made to approach or separate by a transverse screw put in motion by a movable lever. The degree of separation is regulated by a graduated rule placed horizontally, which serves also to maintain the jaws at the same point when separated. The two jaws being introduced between the heels of the shoe, the vice being held perpendicularly to the plantar face, the screw is slowly turned until the branches are opened, say, eight or nine millimetres; then at the point or points of the shoe which have yielded to the pressure of the instrument, one or more blows are struck with a hammer on the outside of the branch of the shoe, to loosen the instrument, until it drops down, without disturbing the screw, a record being made of the degree of dilatation secured, upon the graduated register. After three or four days the same operation is repeated, the spreading being then not more than four or five millimetres. It must be less than at the first, because at the beginning the less perfect contact between the projection of the heels of the shoe and the wall has allowed a considerable amount of dilatation without pro-

FIG. 511.—Defays' Contrary Vise.

ducing much result. These repeated dilatations once in four days for a month, are assisted by the application of soft poultices in horses which, on account of the pain and consequent lameness, are kept in the stable. Others may be put to work, and receive poultices only when at rest, or may be turned into damp fields. The shoe rarely needs changing during the treatment, which lasts about a month. This mode of opening the heels is especially practicable and of easy application, and has the advantage of allowing the use of the horse, whose foot is as well protected as with the ordinary shoe. It becomes indispensable when the dis-

ease has been of long continuance, and is accompanied with much lameness. It is liable to but one contra-indication, and that is when the foot is not sufficiently strong to hold it, by reason of the heels having been pared down excessively. It has been tested for a long time, not only by the Defays, Senior and Junior, but by many others. H. Bouley, in France, with Hartmann and Mayer in Germany, recommend it as an excellent curative treatment. These instruments have been modified and perfected, such as those shown in Figs. 512 and 513.

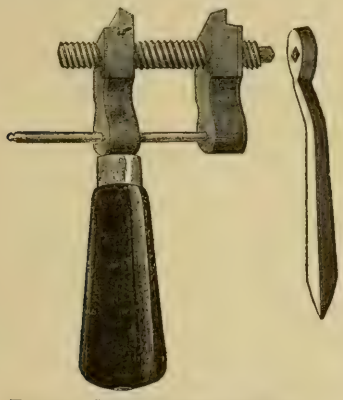


FIG. 512.—Defays' Improved Vise.

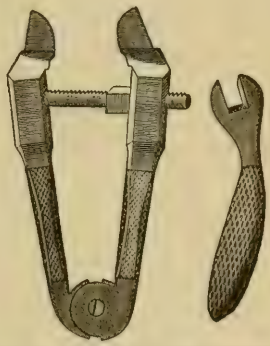


FIG. 513.—Mericant's Desencasteleur.

We must again mention the simple and light desencasteleur of Jovard (Fig. 514), which is as powerful as that of Defays. It is composed exclusively of a double vice, with opposite threads, opening or closing two strong claws, which are applied upon the

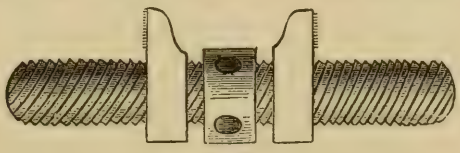


FIG. 514.—Jovard Desencasteleur.

internal borders of the branches of the shoe; a rod of iron is introduced in the holes of the head of the vice and puts the instrument in motion.

It may be said that on general principles it is preferable to treat hoof-bound by the use of dilating shoes than to resort to the bloody operations recommended in earlier times. It is these

that Brogniez recommended highly for the removal of one or two quarters of the wall, with an appropriate dressing. H. Bouley, however, believes that it would be wrong to discard these operations entirely; he believes that there are conditions where they become necessary, and where they furnish better and quicker results than the others referred to.

We cannot overlook the treatment recommended by Barthelemy, which consists in the thinning first with the rasp, then with the drawing knife, of the bars, in their whole length, depth and thickness; thinning them down to a spring under the pressure of the finger. This done, a layer of blister is applied on the skin of the cuti dura and upon it, in the parts corresponding where the hoof has been thinned down; the application to be renewed several times, until the lameness has subsided. This operation is followed by an excess of the horny secretion and a marked enlargement of the hoof, and gives good but slow results. Gross has often operated in the same manner, alternating the blister with poultices.

A *modus operandi* which has also been very satisfactory, is the one that was recently made known by Weber, and which consists in the division of the wall at several points, by grooves extending down to the keraphyllous horn, in the direction of the fibres of the hoof. Two or three are made, on each side, between the quarters and the heels, the heels at the same time being pared down, when a bar shoe is put on which rests on the frog, or if that organ is atrophied, pressure upon it is simulated by the addition of pieces of leather. Frequently, instead of paring the heels down excessively, and when the frog is atrophied, we prefer a slipper after having pared the sole and bars to a spring. The method of Weber is not new. It was previously known by Laguerinière, and is mentioned by Brogniez and Hurtrel d'Arboval. With it we may slowly but surely achieve success, and there are but few feet which are not relieved or cured; but the grooves must be renewed from above at each shoeing. Solleysel made lines of cauterization on each side of the heels, extending from the hair to the shoe, which, running through the hoof, softens it and renders it more tractable.

We cannot at present consider the complications likely to be encountered, but must satisfy ourselves by remarking that in cases of false quarters, to avoid the painful pinching of the soft parts between the two walls, there is nothing better than to clean the

place of separation thoroughly with the drawing knife, and to fill the space with a putty of gutta percha.

Diseases of the Frog.

This part of the horse's foot is exposed to many pathological lesions. Some are merely accidental, and result from the introduction into its structure of nails, and other various foreign bodies, more or less sharp, which the animal picks up in walking or performing his work. We have already considered these forms of lesion in the article upon punctured wounds. The frog is often bruised, a lesion which may be followed by a complication which we may be allowed to consider under the name of furuncle of the frog. But besides this, some special diseases are also observed, among them one already known to us under the name of *canker*, and another which is more commonly known under that of *thrushes*.

(A) Thrushes.—This affection is often, but wrongly, considered as the beginning of canker, being characterized by the presence of a puriform secretion, blackened and very fœtid, which collects and accumulates in the lacunæ and excavations of the frog, whether in its middle or upon its sides. There is often an increased sensibility of the parts, which in some cases may give rise to very serious lameness, preventing the animal from standing, and rendering the movement of walking very painful. The horn of the frog often becomes soft and thready, when the frog is called *rotten*, and the softness increases until it drops off by piecemeal.

The causes of this affection are, first, excessive work on stony roads; changes from excessive dryness to moisture; the strong muds of streets, and standing in damp and dirty places, especially in urine and manure, as is often the case in badly kept stables. But there are horses whose feet are also affected with thrushes even when standing on a dry bedding; those whose feet are contracted; and again, well-bred horses with good frogs, and in which there is a constitutional tendency to that condition of the horny structures.

The treatment consists in avoiding all known causes likely to give rise to this morbid condition of the frog. Sometimes the foot must be pared, and all the parts where the puriform secretion

collects exposed and thoroughly cleansed. The lacunæ of the frog are then to be dressed with Villate's solution, Ægyptiacum ointment and sometimes only with simple drying powders, a mixture of subacetate of copper, burnt alum and tannin. When the pain is excessive, glycerine, with a little Goulard's extract or per-chloride of iron, is very beneficial. Dusting with calomel powder gives also excellent results. In some cases again, excellent results are obtained by poulticing. It is certain that proper shoeing must, in many instances, be of great advantage.

(B) Furuncle of the Frog.—Under this name is understood the partial necrosis of that portion of the plantar cushion which is situated above the frog proper, from a bruise of that part of the hoof. Loiset describes it under the name of *plantar fibro-chondritis*, connecting it with quittor, which he named, *lateral fibro-chondritis*.

Symptoms.—There is nearly always, and especially at the outset, a severe lameness, the greater in degree as the mortification is more extended and more deeply situated. While standing, the affected leg is carried forward, resting on the toe; the heels are raised, and the fetlock is half flexed. In action, the rest is very slight, sometimes quite absent, and occurs on the toe only. As the disease progresses, and the necrosed spot develops itself, the animal rests his foot better, and the lameness diminishes.

Upon examination of the foot early in the history of the case, a small opening may ordinarily be discovered, either on the body of the frog, or in its branches, while at other times there is merely a discharge of a yellowish serous pus of a strong odor, and more abundant in quantity than would be expected from the size of the wound, while surrounding it the hoof is loose and sometimes ready to drop off. If the disease is several days old a mass of dead tissues is ordinarily found partly loose, projecting through the opening of the frog, which has the aspect of a whitish body, slightly green, soft, loose and detached among the surrounding tissues. When this core (bourbillon) is not visible it may sometimes be felt with the finger introduced through the wound in the frog.

If there is no lesion of the frog the purulent fluid accumulates under the hoof, raising and loosening it from the velvety tissues to a varying extent.

Fluctuations may be sometimes even felt under the hoof. Some-

time the pus oozes through the lacunæ of the frog, while again it may then appear at the heels, after making its way under the entire sole.

Pathological Anatomy.—As we said at the beginning, the characteristic lesion of the frog is the gangrene of a portion of the fibrous structure of the plantar cushion, when it changes its general appearance and becomes of livid yellow-greenish color, while at the same time a process of elimination takes place in the surrounding parts, and pus forms, separating the dead tissues from the healthy structure surrounding. This process of elimination is more active on the surface than in the deeper parts of the plantar cushion, to which very often this core remains attached. In some serious cases the disease becomes complicated with necrosis of the plantar aponeurosis, or of the os pedis, and sometimes of caries of the lateral cartilages, or cartilaginous quittor.

Causes.—Furuncle of the frog always proceeds from some violent injury through the horny envelope of the tissues it covers, either when the hoof has been cut through and through by a sharp instrument, or as the result of some simple bruise without solution of continuity, contusion, or even crushing. Any foreign body likely to produce a punctured wound of the foot may produce it. But in such cases as are accompanied by furuncle it is necessary that the wound should be more of a contused or bruised than of the punctured variety. Rough, angular stones are the most common agents of injury, being often picked up between the shoe and the frog, and then, pressing more or less upon the tissues underneath, they produce the same result when they are located in laminæ of the frog.

A thick, voluminous frog in a foot with low heels is very much exposed to the class of injuries under discussion, equally with the frog whose horny covering has been pared too closely.

Treatment.—The first indication, says H. Bouley, when one has to treat a furuncle of the frog, is to thin down as much as possible the horn of the plantar region, and especially that of the frog, of the bars and the branches of the sole, in order to avoid the painful pressure it would produce if its thickness should interfere with the expansion of the parts. This done, if the frog is already punctured, and there is an opening communicating with the cavity where the core (or *bourbillon*) exists, a free incision or opening must be made through the hoof and the fibrous covering

of the plantar cushion, and thus the escape of the pus facilitated. If the horny frog has remained intact, a longitudinal incision must also be made in order to allow the frog to discharge, and avoid further burrowing or undermining of the hoof. It is bad practice to attempt to pull the *core* out with a sharp instrument. It is better to leave it undisturbed and wait for the natural process of elimination, which may, however, be hastened by the application of a poultice. The time required for the entire separation of the necrosed spot varies, and as it approaches, the animal begins to improve in the matter of resting his foot. When it becomes entirely detached, the cavity which it occupied in the plantar cushion is treated as a simple wound, with turpentine or tincture of aloes. However, a dressing supported by the shoe with plates is always advantageous, and must be frequently repeated. No great length of time is usually required for the entire healing of the parts, and the animal is soon returned to his work.

In a few cases, nevertheless, the furuncle becomes complicated with necrosis of the plantar cushion, disease of the os pedis, or of the lateral cartilages, the treatment of which must vary according to the nature and severity of the lesions. In these instances operations similar to those required in cases of deep punctured wounds of the foot or in cartilaginous quittor are indicated.

Keraphyllocele.

This name was given by Vatel to a tumor which forms on the internal surface of the wall of the horse's foot, at the expense of the keraphyllous tissue, which becomes hypertrophied. These tumors are sometimes irregularly rounded, at other elongated, but usually rounded and again flattened from side to side. They vary in size from that of a goose quill to that of the finger, and while in some cases they occupy the whole length of the wall from the coronary band to the plantar border, in others they only begin at one-third or one-half of the height of the wall. The difference in size allows a division of keraphyllocele into *complete and incomplete.* At different points the columns are roughened by frequent enlargements. Sometimes full and formed by a very compact and hard tissue, they are, however, sometimes of a fistulous character and accompanied by a blackish discharge of an offensive odor. The lamellæ of the reticular tissue which are nearest to them are generally wider and thicker than in the nor-

mal state. As the tumor increases it compresses the lamellated tissue and the corresponding surface of the os pedis, injuring the soft parts, and resting in a groove they thus form for their development.

The causes which give rise to their development are more especially cracks of the walls; though they often follow laminitis or supervene upon severe operations on the wall. Vatel claims to have observed them after injuries on the hoof resulting from the hammering of the foot while being shod.

The symptoms are very obscure. At first the animal is but slightly sore in traveling, but the lameness increases as the tumor enlarges in size. The region surrounding the tumor is always warmer and more sensitive than is natural. In many horses the coronet presents a swelling, well marked. In some cases the diseased quarter is depressed, and the toe seems elongated. When a toe or quarter crack is accompanied with severe lameness keraphyllocele may generally be suspected. But when none of these external signs exists it is exceedingly difficult to make a positive diagnosis of their presence, for though the swelling of the coronet, the heat and the pain of the hoof may be present, those symptoms may belong also to other diseases of the foot. Then the only means at our disposal is to pare the foot well down, when, at the surface of the sole, the extremity of a portion of hoof ordinarily harder than the normal consistency may be detected.

The treatment consists in removing the portion of the hoof corresponding to the horny tumor, as in a case of toe cracks, and treating the wound thus made in the same manner, according to the indications presented.

Laminitis.

Synonyms: *Behe, Verschlag, Hufentzundung*, German; *Fourbure, Fourbature*, French; *Rifondimento*, Italian; *Aguadura*, Spanish.

By this name is understood the bloody congestions of the keratogenous apparatus of ungulated animals. The increase of the circulating fluid produces a swelling of the living tissues of the foot; but these being enclosed in a box of so hard, resisting a material, a painful pressure results, which becomes especially common and serious in horses and other solipeds. It has also been observed in bovines, though it is then less frequent and

serious. It has also been seen in sheep, in goats and in swine. It may, in fact, occur in all ungulated animals. Dogs, even, are not exempt from its attacks.

The simple bloody congestion, more or less inflammatory, of the keratogenous apparatus of the horse, is sometimes called *acute laminitis* and *acute founder*. The disease may pass off by resolution, leaving no traces of its occurrence, but more commonly it becomes complicated with some lesion of more important and serious a character, as hemorrhage, suppuration, inflammatory exudation, and especially of a hypersecretion of the horny substances, in which case it becomes *chronic* laminitis or founder; an affection which gives rise to alterations of a peculiar nature, and leads to certain changes in the form and character of the hoof. We do not agree to the divisions admitted by several authors, into *traumatic laminitis*, *rheumatismal laminitis*, and *metastatic laminitis*.

I. *Symptoms.*—Laminitis, in most instances, is preceded by certain general symptoms, such as are premonitory of the invasions of ordinary inflammatory diseases, but of an uncertain significance. There is dullness, general insensibility, muscular tremblings, and stiffness of the loins. The respiration is accelerated, the pulse febrile, the mucous membranes injected, the mouth dry, the fœcal discharges dry and coated, the urine scanty; and perhaps anorexia is present. Rodet, who held that laminitis is more a secondary than primitive affection, and that it is simply an inflammatory angeiothenical fever which had localized itself, was obliged to acknowledge that this fever has nothing characteristic, and that it is always followed by laminitis.

It is certain, however, that but a short time elapses—from several hours to one or two days—after the originating cause has become active, before the bloody congestion of the reticular tissues and the peculiar phenomena belonging to the disease become manifest. It is only when the capillary circulation of the foot has considerably increased, and when the rigidity of the structure prevents the swelling of the podophyllous tissue, that laminitis truly exists.

Laminitis in the horse has the following principal symptoms: Considerable heat of the entire foot, extreme sensibility with intense pain, increasing rapidly, and obliging the animal to rest upon the sound legs, in order to relieve the affected ones; diffi-

culty and uncertainty in walking; and sometimes a peculiar trembling of the muscles of the patellar face of the femur, and of those of the extensors of the fore arm, which fill the triangular space formed by the scapula and the humerus. The physiognomy always indicates intense suffering. The pulse is hard, the respiration increased, and the skin hot, and in places moistened by a copious perspiration. These symptoms vary with the legs which are affected, whether the disease is located in the fore or hind feet exclusively, or in all four together. As M. Bouley says, it is a peculiarity of this affection that it may remain localized in the feet of one patient, either forward or behind, or may at once attack the four extremities, and that it seldom attacks the limbs on one side only, to the exclusion of the feet of the opposite side, *i. e.*, it may be laterally biped, affecting either both the fore or both the hind feet, but not often occurring otherwise. Sometimes, however, the disease is more marked in one leg than in the other of one biped. It is generally only after some traumatic lesion, or other local influence, that laminitis occurs in one foot only.

When laminitis affects the two anterior feet, the animal carries its extremities forward, and the hind feet are brought well under the centre of gravity. The standing of the animal is altered, the walking difficult and painful, and the resting of the feet on the ground is done with hesitation and fear. The feet are carried forward, because the pressure takes place on the frog and on the heels; if it should occur as in the healthy and normal condition, upon the entire inferior circumference of the foot, there would be pressure upon all the living tissues, which are gorged with blood, tumefied and painful, and this pressure would greatly increase the suffering of the patient. It is, then, to relieve himself, and to avoid the intensity of the pain, that the animal instinctively changes its mode of resting on the ground. In placing the heels down, the weight is borne only upon a follicular, fatty tissue; from there it spreads along the side of the coronet to the fetlock, and thus upon all the other portions of the leg, and in this way the foot becomes greatly relieved during the action of resting. If, however, the fore legs only were carried forward, the effect would be equivalent to lengthening the body of the animal, and he would be unable to carry on the action of walking. To allow the fore feet to be moved, it is necessary that the body be carried

forward by the hind legs and brought closer under the centre of gravity, a position which contributes also to the relief of the animal while at rest.

The more painful and diseased the feet become, the more the animal fears the impingement of the ground. Thus, so to speak, he sounds the ground before putting the foot down, and for this reason the walking becomes slow, stiff and difficult, and the noise of the contact of the foot louder than that of the healthy legs. Sometimes the animal proceeds only by a series of jumps, or a kind of rearing, while backing is especially difficult.

The hoofs of the foundered feet give to the hand, when feeling them, a sensation of heat greater than that in the physiological condition; a sensation which can be more readily detected by a comparison of the fore and hind feet simultaneously examined. The pains in the diseased feet are rendered more manifest, also, by percussion upon the hoof with the hammer, when each blow, however light, is followed by a motion of the animal in suddenly withdrawing his foot on account of the pain experienced. The lateral arteries of the fetlock, in the foundered legs, beat stronger than in health, and can be readily felt by the fingers. The feet cannot be raised without great effort, and when raised, the animal stands only with great difficulty, and makes struggling attempts to relieve himself and resume its natural mode of standing on four legs.

When laminitis affects only the fore feet, the animal will sometimes remain standing for a length of time together; he may retain this attitude for several days, without any displacement of his body; still he is observed moving *surplace*, from side to side, especially on his fore legs, relieving one foot for a moment to give the same comfort immediately afterward to the other. But when, exhausted by fatigue and pain, the foundered horse lies down, it is very difficult to get him on his feet again. He continues in the decubital position, lying mostly flat upon his side, the fore legs in constant motion, and soon complicates his diseased condition by the addition of bed sores upon the prominent parts of his body.

The attitude of the animal is very different when the hind feet are affected; then both the anterior and posterior bipeds are brought to each other, the feet of the hind legs being carried forward under the abdomen, so that the rest may take place upon the heels; and the anterior ones are carried backward, and nearer

to the centre of gravity, to assist the function of the hinder extremities in sustaining the weight of the body. In this case, the animal is constantly in side motion, on account of the pain he endures. Walking is still more difficult, and seems to take place as if the animal was treading on sharp needles, as, the more the anterior biped is engaged under the body, the more also those legs are loaded with the animal's weight, and the more difficult is their movement. But the anterior legs, contrary to their ordinary function (not being adapted to the support of an overshare of the body) sustaining now a great part of its mass, and moreover, compelled to assist in the act of propulsion, necessarily and inevitably become easily fatigued, and too often in their turn become likewise affected. Animals suffering with posterior laminitis are found occupying the standing position less frequently than those whose fore feet are affected. Their unsteady equilibrium, consequent on their mode of standing, tires them more quickly, and compels them to lie down, and once on the ground, it is again more difficult to make them rise. They may do so readily with the fore legs, but the posterior extremities do not always respond to the call.

The attitude of animals suffering with laminitis of all the four feet, is the same as of those which are affected in the fore feet only. All four feet are carried in advance of their plumb line, the anterior forward, the posterior well under the centre of gravity. Sometimes the horse has all his feet somewhat apart, in order to carry the principal part of the weight on the inner side of the foot. The standing posture being painful to either foot, the animal lies down most of the time. Locomotion is very difficult and staggering, and the animal can only be induced to move by severe punishment, and even that cruel resort sometimes fails to effect it. If the animal is made to walk, he does it with the greatest difficulty, by reason of the increase of his sufferings, brought on by the displacement. His legs, stiff and trembling, are raised in a convulsive manner, and brought back to the ground with the greatest hesitation, and upon the heels; the constant motion of the lips of the animal being well characteristic of his sufferings.

In the ox, laminitis is more frequent in the hind than in the fore feet. It is, however, more serious in the latter, the inner being more affected than the outer toe. The foundered ox walks with hesitation, and takes advantage of every opportunity to lie

down. When standing, his back is arched, the feet closed together, the hind feet resting on the heels, the fore legs on the points of the toes. The fever is severe, sometimes attended with loss of appetite and of rumination. If the disease continues long, the cattle will die. The abdomen is stuck up and the animal loses flesh very rapidly, indicating a serious condition, as the disease is principally found in fat animals, which are obliged to make forced marches to be delivered at their markets.

II.—*Termination and Complications.*—Well treated, laminitis is generally of short duration, and ends in three or four days by *resolution.* Sometimes, however, this is not accomplished until a later period, even toward the tenth day, though cases of this character are rare; and even when resolution proceeds slowly, some lesions in the foot may be looked for, and chronic laminitis will probably result. Resolution in acute founder is marked by the gradual disappearance of the local and general symptoms. In some subjects, the improvement is quite rapid from day to day, and the form of termination is known as delitescency. Laminitis ending in resolution is not usually followed by alterations in the horny box or the tissues which it covers.

When the congestion which constitutes the disease terminates otherwise than by resolution, it is always followed by accidents of varying character. Some of these may have a happy termination, but, in the end, are more or less likely to be followed by a deformity of the horny box, to which the name of *chronic laminitis* is given. Before entering upon this, however, let us examine the various complications which may follow acute founder, and study in succession: the *hemorrhage*, *inflammation with exudation*, *suppuration*, *gangrene*, *consecutive arthritis*, *metastasis*, and, lastly, *chronic laminitis.* Resolution is most commonly met with in the ox. Sometimes the separation of the hoof by suppuration occurs, and chronic founder is not observed in that animal. It is seldom that seedy toe is observed.

a.—Hemorrhage, or *apoplexy* of the reticular tissue, is due to the rupture of the excessively distended capillaries, when the extravasated blood either infiltrates into the meshes of congested tissue, or spreads around it, and penetrates between the podophyllous and keraphyllous lamellæ, filling up the spaces at the toe, the mammæ and the anterior parts of the quarters, the os pedis being pushed back by the pressure of the incompressible fluid. The

pain is then very great; the blood, continuing to separate the tissues, often oozes at the coronary band.

If this last sign is absent, a groove may be made with a drawing-knife in the region of the toe, behind the commissure of the sole and of the wall. If we meet with a cavity, resulting from the extravasation of the blood in the podophyllous and keraphyllous space, or if blood flows out from it, the true nature of the complication becomes at once apparent. This mode of exploration is generally difficult, as the animal in pain does not readily allow his feet to be raised, and as the other foot cannot sustain the entire weight of the body, the horse easily falls down. It is sometimes necessary to throw the animal in order to make this exploration, which very often becomes necessary if we would know accurately the progress of the disease.

b.—Inflammation, with fibrinous exudation, or pseudo-membranous formation on the surface of the podophyllous tissue. The transudated fibrine mixes with the hoof, secreted by the podophyllous tissue, and this matter separates that structure from the keraphyllous laminæ, especially at the anterior part of the region. Again, in chronic laminitis we find this abnormal secretion pushing the os pedis forcibly backward and separating the toe of the bone from that of the hoof, and thus producing a pain still greater and more violent than that produced by the laminitis and the hemorrhage. These pains are often so intense that they give rise to an access of furious vertigo. But pains, even when of an exaggerated degree, indicate simply the presence of the exudative form of laminitis. It is not a positive sign; the foot must be explored at the toe, where, in the vacuum which exists between the horny lamellæ is found, more or less abundantly, a citrine serosity of a slightly reddish color. Sometimes this serosity oozes between the hair and the hoof, in consequence of the separation of the tissues at the coronary band, and appears in the form of a thin, reddish foam, about the band itself.

c.—Suppuration between the wall and the podophyllous tissue is a complication more rare than the others, but which, however, has been observed, especially when laminitis is traumatic. We have seen it appear under the sole and separate it entirely from the tissues underneath. In these cases, the pain is always very great, and the living structures are pressed beyond measure. Standing is impossible, and the animal continues lying down, or,

under the influence of the pains, constantly moving from one leg to another, balancing himself, so to speak. There is no relief for him until the suppuration has shown itself between hair and hoof, when it oozes outward at the coronet. Relief, however, may also be obtained by making an opening at the toe with the drawing-knife. This complication often results in the entire separation and dropping off of the hoof. Cases have been observed when this accident has taken place as early as the third day (Lafosse, Stanley). Gillmeyer has seen a new foot grow out entirely, but this requires a long time.

d.—*Gangrene* of the sub-horny tissues sometimes takes place, though seldom, under the influence of the excessive pressure, especially when there is sub-horny exudation. The violent pains then cease suddenly; the resting becomes more solid; the movements take place without difficulty. But at the same time, the physiognomy of the patient becomes anxious and contracted; the pulse becomes small and difficult to count; the temperature of the body diminishes; the animal has a trembling gait; is indifferent to any excitement; he is prostrated, and soon he ends by septicæmia. The hoof then often drops off, and the sub-horny tissues are seen to be of a bluish-brown color, without consistency, but with a very fœtid odor.

Volpi thought that laminitis was the inflammation of the articulation of the foot; but this *arthritis*, if it exists (a fact which is rare), is not a consecutive phenomenon, but a complication. The inflammation does not remain limited to the recticular tissue; it extends also, and consecutively, to the contiguous structure, spreads to the tendons and articular ligaments, even penetrates to the synovial capsules of the articulation of the third with the second phalanges, and may also react upon other parts of the organism. The anchylosis of the articulation of the foot with that of the coronary joint are complications somewhat frequent, as well as that of the ossification of the cartilages of the foot.

e.—*Metastasis* has been often observed, and when accompanied by intense fever have been noticed as complicated with serious diseases of the chest, especially of pleuro-pneumonia. At other times, it has been the intestines to which the metastasis has transferred the disease, in which case there is, in most instances, constipation of the bowels. Enteritis, however, is seldom observed, notwithstanding what has been said on the subject. This

metastasis has also been seen toward the lumbar region, and this is much more commonly believed from the fact that there is more motion at the hip than at any other joint during locomotion, and also because the back and the loins are more or less arched. In fact, laminitis has been, by some, designated as an affection of the loins; some have looked upon it as a rheumatism of that region. All these errors have originated in the peculiar motion of the animal while walking, or of its peculiar mode of resting when standing still. We have also observed an attack af complete myelitis as a complication of laminitis.

f.—The most common complication met with in *chronic laminitis* is an affection which we might have treated as a special subject had we not, upon principle, considered it as a sub-inflammatory state of acute founder of the foot. An attack of laminitis which has not ended by resolution in five, ten, or fifteen days at most, takes a character of persistency which, in most cases, ends in absolute incurability. To properly study chronic laminitis we must observe it when the alterations which characterize it are accomplished. When we have completed the consideration of the pathological changes, we will examine the intermediate period, and discuss the mechanism by which these alterations take place in relation to the pathological anatomy.

The first thing observed is the change of form in the hoof (Fig. 515). The nail of a horse's foot easily recalls the form of a Chinese shoe (Knollhuf, of Germany). The hoof seems to have also lost its varnish and its suppleness in the points corresponding to the diseased parts. It is, besides, brittle, and seems to have lost part of its connection with the remaining parts of the foot, and there is a change in the direction of the wall, the fibres of which, instead of being oblique to the ground, assume an almost horizontal direction. The foot seems as if flattened from above downward, and the lines which bound its surface form a well-marked obtuse angle with that of the coronary region. The anterior wall of the foot also forms a well-marked projection forward, from which results a great exaggeration of the antero-posterior diameter of the nail with the transverse diameter and the oval form of

FIG. 515.—Chronic Laminitis.

the horny box. The external surface of the wall, instead of being smooth, as in physiological conditions, presents, on the contrary, a roughened appearance, which results from the presence of circles of ridges and circular grooves, placed one above the other and extending from one heel to the other. A remarkable peculiarity is here observed in the fact that in the anterior part of the nail the circles are quite near each other, while, on the contrary, upon the lateral parts they are separated by much wider grooves. When, then, at the toe, the wall has some difficulty in growing downward, on account, probably, of the internal adhesions between the podophyllous and keraphyllous tissues; the heels, on the contrary, grow without difficulty, and thus obtain a relative height superior, and sometimes even equal, to that of the toe. Often at the mammæ and quarters of the foot contractions are seen, and longitudinal grooves running from the coronary band to the plantar surface, reminding one of the lesions usually met with in encastelure.

FIG. 516.—Chronic Laminitis, last stage.

Considered on the side of the inferior face, the old founddered hoof offers four remarkable lesions (Fig. 516). Besides its oval form, a disposition altogether different from that of the normal state, the sole is convex in all the anterior part of the plantar region, especially at the point of the frog. There exists at that point a transversal tumor or enlargement, projecting sufficiently to exceed in height the inferior border of the wall. The solar sheet has been pushed outward by the pressure against the superior face from the contents of the horny box, and the foot is convex. This convexity never equals the entire extent of the foot, the deformity ending at the boundary of the inferior border of the bars, beyond which and backward are found the cavities of the lateral lacunæ of the frog, so much more elevated as the heels are also higher (Fig. 517). The center of this tumor or enlargement of the sole is often flexible under the pressure of the finger, and generally bleeds easily on the application of the sharp tools of the blacksmith. It is not rare to see the sole perforated through and through and showing the inferior border of the os pedis projecting through the border of the bone, which then soon becomes

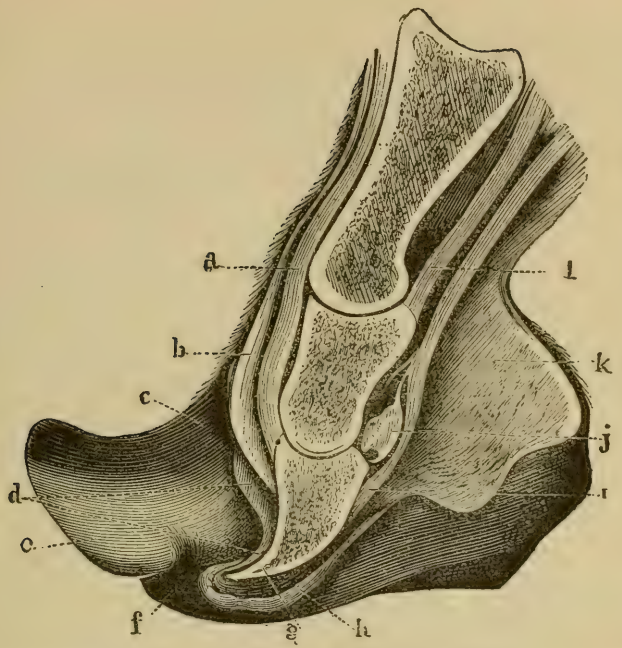


FIG. 517.—Foot affected with Chronic Laminitis.

a.—Anterior extensor of the phalanges. *b.*—Ordinary wall. *c.*—Coronary band. *d.*—Podophyllous tissue modified. *e.*—Morbid horny wall. *f.*—Seedy toe. *g.*—Displaced and deformed os pedis. *h.*—Velvety tissue. *i.*—Perforans tendon. *j.*—Navicular bone. *k.*—Perforatus tendon. *l*—Plantar cushion.

necrosed. This is the result of the excessive displacement of the os pedis and of the strong pressure upon the velvety tissue against the sole-tissue, which is atrophied or even destroyed (Fig. 518). This is an ulcerating wound, somewhat semi-lunar, secreting a

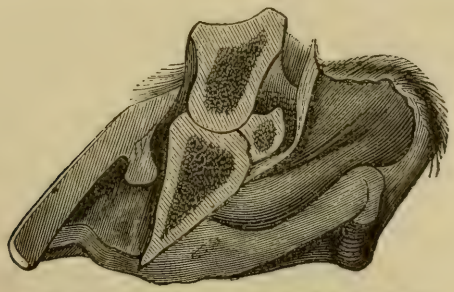


FIG. 518.—Chronic Laminitis, with Keraphylocele

very offensive pus, with granulation and proud flesh, or even separation of the sole.

Between the sole and wall the line of demarcation is no longer so well defined as in the normal state. At the toe, the mammæ and the anterior part of the quarter, there is an excavation formed of softer horn of bad nature, and less identified with the true horn of the wall and of the sole. A complete vacuity is often found, a cavity around the internal face of the wall at the toe and at the mammæ of varying depth and size, but always larger at the inferior than at the superior end of the foot, where it gradually diminishes, and often contains a dry, granular mass, resulting from the drying of the blood, and the dried plastic lymph, mixed with small, horny, pulverized masses. This cavity is formed in front by the healthy wall and posteriorly by a new wall due to the secreted hoof thrown upon the podophyllous tissue; this is called *seedy toe.* This double wall is observed especially after laminitis of the hind feet; it is more common in the donkey and the mule; it is also noticed in horses with small feet, as in those of Oriental breeds.

The deformities of the horny box due to chronic laminitis are not in all cases identical in their character; there are degrees in them, and consequently they vary in their features, which variations are due to the duration of the disease and its intensity, and also, according to H. Bouley, to the primitive form of the diseased foot. In a case of chronic founder of the fore feet, one may often notice a difference between the deformity of the left and that of the right foot. The deformities may take place at various times, and one may find a well-marked case of seedy toe while as yet the wall has preserved its normal oblique direction and shown rudimentary ramy appearances. Again, the wall may have undergone changes in its direction only at the new hoof, which grows from the coronary band; there is then formed between the old wall and the coronet a circular groove, sometimes called the *digital cavity*, the deformities of the wall taking place only as it grows down. At times, also, instead of the groove, there is a ridge of horn at the coronary band, originating in the hyper-secretion of the horn, which grows also downward. And, again, there are cases where there is seedy toe and still no well-marked alteration of the shape of the wall of the sole.

Chronic laminitis is always accompanied with more or less

lameness. There are cases, however, where it is missing; for example, in seedy toe. Ordinarily, the foot is raised from the ground with a convulsive motion, as may be well observed in donkeys and mules, which animals rest their feet on the heels. This soreness diminishes with time, as the foot, assuming its new form, offers a wider space to the sub-ungulated tissues and presses less upon them, these tissues having, at the same time, become somewhat atrophied. In cases of hernia of the os pedis, the resting of the foot on the ground is almost impossible, the animal being afraid to bear his weight on the sole. The heat and the pain of the feet are less marked. The percussion is louder in case of seedy toe, while it is duller when the space between the wall and the recticular structure is filled with hoof of new formation. This percussion is very painful in case of keraphylocele. Unless there are serious lesions, chronic laminitis is not accompanied with fever.

III. *Pathological Anatomy.*—At the initial period of laminitis, when there is only simple congestion of the keratogenous apparatus, and especially of the podophyllous tissue, the sub-horny tissues are in a condition of sanguineous derangement, characterized by objective signs. When the hoof covering them during life is removed, they are found of a dark red color, in a kind of eythema. When pressed between the fingers, their thickness is noted to be increased, and they are found to be gorged with blood, an incision made through them allowing the escape of a large quantity of that fluid.

If the laminitis exists for several days, the podophyllous tissue is found to be infiltrated with plastic exudations, and if there has been hemorrhage or apoplexy, blood is found between both the sensitive and insensitive laminæ. In other cases there is pus, and in case of gangrene, the tissues are found of a livid color.

The alterations are still more serious in cases of chronic founder. When a foot, foundered for some time, is divided by the saw in its antero-posterior axis by a section of all the parts, the thing first noticed is a change in the connection of the os pedis with the wall. These changes, however, exist principally at the toe, and extend as far as the half of the quarters, on a level with the lateral cartilages of the foot, while further backward they are not to be observed. On the side, some laminæ are always found in their normal condition, as can be seen by a section of the foot made transversely. Generally, a yellowish substance, of

horny appearance, but softer, fills up the space situated between the walls and the keratogenous structure. This is the product of the exudation of the inflamed podophyllous laminæ, mixed with the horny substance which they secrete normally. These laminæ are themselves hypertrophied, being sometimes one and two centimeters in length and exceeding by four or five times their normal size. The keraphyllous laminæ are also hypertrophied, a condition which is evidently due, as respects the podophyllous tissue, to the increase of vital activity, resulting from the inflammatory condition of the tissue and to the infiltration by fibroplastic exudation, resulting from the inflammation. As to the keraphyllous laminæ, they repeat on the internal face of the wall, in an inverse manner, the disposition of the secreting laminæ of the hoof between which they are formed and lodged. These, however, as they increase in extent, unite at their base in the whole of that portion which does not co-operate to their union with the podophyllous bands, and then forms a compact mass uniting most frequently with the internal face of the wall. Sometimes this mass of yellowish hoof occupies the whole space between the os pedis and the wall, but, in some cases, it adheres only to the wall, when it forms around the keratogenous tissue, a new wall, also provided with keraphyllous laminæ, and there is formed between it and the normal wall that porous, brittle mass, without homogeneity, which fills up the space, which constitutes the seedy toe. The mass thrown between the wall and the os pedis presses upon it; the anterior face of the bone assumes a vertical direction, and the os pedis presses toward the solar arch on its anterior border at a point situated posterior to that where, in normal feet, this border rests. Notwithstanding its resting power, the wall gives to the effort of the mass interposed in front, the form of the foot changes, and then results the change to the oval in the contour of the foot. Under the influence of the displacement of the phalanx, not only the flattening and afterward the convexity of the sole and even its perforation results, but the plantar cushion is itself pressed down and crushed between the bone and the frog, which is then generally atrophied. A hoof of new formation is often developed between the sole and the inferior face of the phalanx, in order to prevent it from necessarily sinking. This increases the pressure upon the bone and contributes to its atrophy and sometimes to its complete disintegration.

But, between the surface of the coronary band and the origin of the roof, whose formation is anterior to the laminitis, there may also be a new layer of hoof, more resisting than that which occupies the space between the wall and the podophyllous tissue, which is no more hoof mixed with the fibrinous exudation, but a pseudo-hoof secreted by the coronary band. The fibres of this hoof, however, instead of being rectilinear and growing down in the direction of the old wall, with the fibres of which they are continuous, are, on the contrary, sinuous and nodulated, and disposed to take a somewhat horizontal direction. There is often, besides the old wall, a deep horny tumor, a keraphyllocele which grows inside, attempts to replace the soft horn secreted by the podophyllous tissue, and adds to the pressure of the os pedis, by forming a new wedge, more solid and resisting, which produces a displacement of the phalanx, whose anterior face then often becomes more than vertical. This horny secretion from the coronary band is made evident by a section of a foundered foot, when the cutigeral cavity will be found much enlarged. Guyon, Jr., Hertwig, and Gourdon remark that the displacement of the os pedis is counterbalanced by the more rapid development of the heels and the projection of the foot forward; and that thus the phalanx does not support the weight of the body except by its inferior border only, but preserving nevertheless, its primitive position. It is especially observed that when the foot is completely deformed, the projection of the wall does not prevent the os pedis from remaining in its normal position.

The growth of the hoof from the podophyllous tissue and the coronary band is not easily stopped. The horny masses which are formed continue to increase, and even soon end in uniting. There then remains a thick mass of deformed shape, four or five times thicker than the normal wall, but where the keraphyllous leaves are still noticed, corresponding to the podophyllous laminæ, largely developed, and above all, running deeply into the wall of the hoof. The space between the wall and the anterior face of the os pedis is filled with pus besides the secreted hoof; the seedy toe, if it existed, disappears. Though the hoof becomes thus much more voluminous than before, the deep parts are not any more in their normal condition, but are lodged in a smaller and smaller space, and are thus in such a state of compression that they become atrophied. The bone is altered in its texture, as

FIG. 519.—Changes of Structure of the Os Pedis in old cases of Chronic Laminitis.

well as in its form, and becomes denser and more brittle. (Fig. 519). One might suppose that as the disease progresses, the os pedis would become pressed backward more and more toward the sole, in consequence of its giving way under the pressure. This, however, is not so. As the old normal walls disappear, the new horn yields to the pressure from forward, the heels rise, the os pedis resumes its horizontal direction, and the danger of hernia of the bone diminishes, and a hypersecretion of the hoof is even noticed toward the point where the hernia would have taken place, in the middle of the pumiced sole.

We have, so far, supposed that chronic laminitis is always manifested by the presence, between the internal face of the wall and the podophyllous surface, of a mass of abnormal hoof. But there are cases, after hemorrhage, and especially after serous exudation, where, instead of it, a cavity is found—a seedy toe. There is also an entire separation between the os pedis and the wall. But the horny production, that of the podophyllous tissue especially, is not sufficient in amount to fill up the whole space, there being hoof only upon the podophyllous tissue. There is then a sound wall formed, separated from the old one by a vacuum, which is often filled by a dry mass derived from the blood and serosity, mixed with the horny cells. But more frequently

the separation is limited to the height of the podophyllous tissue, and the wall yet remains adherent to the coronary band, by its cutigeral cavity. The band then continues to produce the external wall of the hoof, while the podophyllous produces the abnormal wall, and the seedy toe remains between the two walls.

There are cases where the separation, produced by the congestion of laminitis, takes place to such an extent, in circumference or in height, that the hoof loses all its adhesion, except toward the heels; and then one may see the curious fact of the new generation of an entire new nail within the old one, the former being, so to speak, sequestered in the latter.

IV. *Differential Diagnosis.*—It is possible that, notwithstanding its distinctly characterized physiognomy, laminitis, of the hind feet especially, may be mistaken for a disease of the spinal region. Often, when the founder is light, the hinder parts wag, as in sprains of the loins, but the resting of the feet on the heels, their heat and their sensibility, will soon point out the distinction. In more severe cases, the hinder founder may stimulate paralysis, especially if the animals cannot or will not raise themselves. Here the history of the case is very useful, and the explorations of the feet will assist in making the diagnosis. We have seen cases of laminitis behind, where the raising of the foot has been such that it might be taken for springhalt, or even for locomotor ataxy. It may be also taken for tetanus when in mild form, or yet incompletely characterized.

V. *Prognosis.*—Laminitis is so much more alarming and rebellious as to treatment, as it is more extensive, more serious, and of longer existence. The most serious cases are those which are due to a constitutional predisposition, and those which follow a general alteration, or are complicated with other diseases.

Chronic laminitis is especially serious from the production without separation, and in an excessive measure, of the horny substance. Seedy toe is then less serious, and that which does not extend to the coronary band is sometimes curable by the gradual growth of the hoof; the tumor of the os pedis is the most rebellious to treatment. The destruction of patients is often necessary, from their inability to walk or to do any work, and that notwithstanding all treatment they are entirely useless.

VI. *Etiology.*—Laminitis has been attributed to many and the most varied causes, and, among others, has now been ascribed

to a traumatic origin, consisting of injuries of the foot; and again, to internal lesions, resulting in the inflammatory process which is characteristic of the affection.

The external traumatic injuries, which it is claimed are those chiefly instrumental, are, on the contrary, of very rare occurrence as causes of the disease. Our observations agree with those of H. Bouley, and if there is a traumatic causation for this disease, or, at least, one identical with it in respect to symptoms and primitive lesions, it is, nevertheless, certain that its progress is very different; there is found with it an evident tendency to suppuration instead of exudation, and there is no such formation as the chronic process which is found when laminitis is due to an internal phlegmasia.

It has been said in reference to the action of the heated shoe upon the hoof, the percussion of the blacksmith's hammer and the pressure of the shoe and of the nails upon the living tissues, that all these causes together must, as their sure effect, make the foot tender, and stimulate in its constituting structure, the congestion which is the initial phenomenon of founder itself. But this assumption may be successfully contested. But shoeing may produce many forms of lameness; never laminitis. It has been said that feet of defective conformation are more commonly affected with founder that those which are well formed. This, however, is not so; feet with contracted heels are no more predisposed to it than flat feet, as claimed by Girard. Traumatic accidents, as blows, injuries and pressure, produced by stones, crushing of the feet under heavy weights or under the wheels of a truck, etc., may produce a violent congestion of the reticular tissue of the foot, and consequently laminitis. But this founder itself is of too active a character and more complex, perhaps with a natural tendency to suppuration, as we have already said. It must then be considered as varying from laminitis proper, or that form in which the congestion is of a more passive character, or at least internal and somewhat analagous to that which is sometimes observed in the lungs or in the intestines. It might be better described as an "astonishment" (*étonnement*) of the foot, as it is sometimes called.

Laminitis proper is rarely due to a unique cause, but more properly to a number of circumstances or to an assemblage of various causes by which the horse is at first somewhat indisposed

—sick in fact; and it is only after various general symptoms that the disease localizes itself in the feet, or, as the old phraseology has it, falls in the feet.

The most effective cause is too abundant and especially too substantial feeding, which produces plethora by rich blood. It is the use of other grains than oats, as wheat, barley or rye, which especially predisposes to the disease. Latin authors called it *hordeatio* (from *hordeum*, barley), and it is mentioned by Solleysel, Garsault, Gaspard de Saunier, and various hippiatrics. Rodet has observed its bad effects in Egypt and in Spain, where animals were fed not only with those grains, but where they received wheat in spike. Miltenberger had observed the same effects during the war of 1812, in Poland, where the horses were fed with rye. Even in our days laminitis is seen breaking out in the years when feed is scarce and when oats have to be replaced by other grains, as is proved by the observations of Bouley, Verrier, Rey, etc. Artificial varieties of fodder also predispose to founder, though less often; even oats, when given in excess, may produce it (Solleysel, Blind), and especially if new oats (Hertwig).

The influence of seasons cannot be denied, and it is during the summer months that laminitis is more frequent, while it is rare in winter, as well as in the spring and fall. It is to the warm climates of Spain and Egypt that Rodet attributed, in great part, the frequency of the founder observed in the army horses engaged in campaigning in those countries. It has been also attributed to the sudden checking of the perspiration, and cutaneous chills when the animals are sweating; a cold bath or the drinking of cold water at that moment having also often been considered as occasional causes.

The work of the horse greatly influences the development of laminitis. It is more frequent in those which are driven at great speed than in those which work while walking, and especially in whose frame an excess of strength is required, and particularly those which labor on rough and stony ground. It is almost inevitable if the animal is well fed, and if he is unaccustomed to that kind of work and not trained for it, and most especially if it is during warm weather. This explains why the disease was so frequent among post, diligence and coach horses, especially during the period preceding the establishment of railroads, when the expenditure of strength exacted from these unfortunate animals

reached the last limits of possibility. More recently, again, during the war of 1870–71, when railroad traveling was more or less impeded, laminitis became more common among horses from which an excess of muscular effort was required. It is a frequent and very serious accident among English race horses (Hering).

Laminitis in oxen is due almost exclusively to the fatigue of long journeys and to repeated frictions of the unshod feet upon the ground. It was very common before the era of railroads in animals brought to market.

But prolonged rest and inaction also predispose to founder. The disease is frequent in horses making sea voyages. It is not rare to see horses become foundered when they are obliged to stand up during several days in consequence of injuries to the extremities, or other pathological conditions, requiring them to be kept in slings. In diseases of the feet which have required painful operations (toe or quarter cracks, punctured wounds of the feet, quittor, etc.) it is quite common to see an animal persevere in maintaining the standing position, and too often has the leg corresponding to one first attacked become also affected, leaving both of the anterior or both of the posterior ultimately affected in a serious manner.

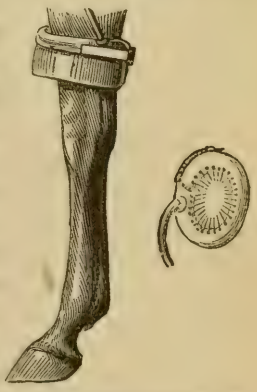
It is common for laminitis to follow intestinal congestions, especially if these result from the administration of a drastic purge, as aloes for example, and this is a very serious form of the disease. Tisserand has seen laminitis of the anterior extremities following parturition in mares, and particularly after abortion. Gloag and Smith have observed similar facts. Hertwig says that it sometimes follows rheumatismal affections, especially the acute form.

A metastatic laminitis has been seen following diseases of the chest. H. Bouley does not believe in these cases, and thinks the laminitis is the effect of the quadrupedal standing position, or also the feeding with farinaceous substances in too great quantity. At times, founder accompanies malignant fevers, such as anthrax and typhoid attacks, which are always accompanied with a certain alteration of the blood

VII. *Treatment.*—In acute laminitis all attempts must tend to remove the congestion of the keratogenous apparatus, or at least to abate its intensity, so as to prevent or diminish the serious sequelæ that may too often follow. To effect this, general or

local bleedings have been specially recommended, with antiphlogistic applications upon the congested regions. General bleeding at the jugular is especially indicated; a large bleeding of from five to ten litres, repeated if the pulse or the condition of the disease indicates it. Local bleeding, often recommended, seems to us, generally speaking, to be useless; that of the toe is of difficult performance in founder, as the feet are usually raised from the ground with difficulty, and the operation is quite painful, and may give rise to more or less serious complications. However, in serious cases it can be done while the animal is thrown down, not so much on account of the blood depletion as to prevent the possibility of gangrene supervening. It is more useful in the ox, according to Lafosse, who recommends to pare the foot down to the quick and to put on the shoe again if the animal has to continue its journey.

The topical applications employed are varied and numerous; the simplest and most practical is cold water, cold baths at half the leg (Fig. 520); take in running water, if it can be done, and if the animal stands up; walking in the water is then recommended, if practicable, walking increasing the venous circulation of the part. Instead of running water, ponds, marshy grounds, pools of stagnant water, or even liquid manure may serve the same purpose. In establishments where horses are numerous, there are special tubs where the water is constantly changed. The animal may be placed in some of these, up to his fetlock, in an astringent solution. Mathew has invented an apparatus for continued irrigation, consisting of a reservoir of water elevated above the body of the animal; around each coronet is placed, in shape of a bracket, a tube of india rubber, perforated with holes opening on the hoof; from the reservoir runs a tube which bifurcates and furnishes to each leg a descending division connected with the bracket (Fig. 521). The water is then allowed to run around the coronet and drip over the foot. Instead of simple water, the use of snow or broken ice has been recommended, wrapped in cloth round the hoof; pads of oakum dipped in solu-



FIGS. 520.—Local Cold Douch Application.

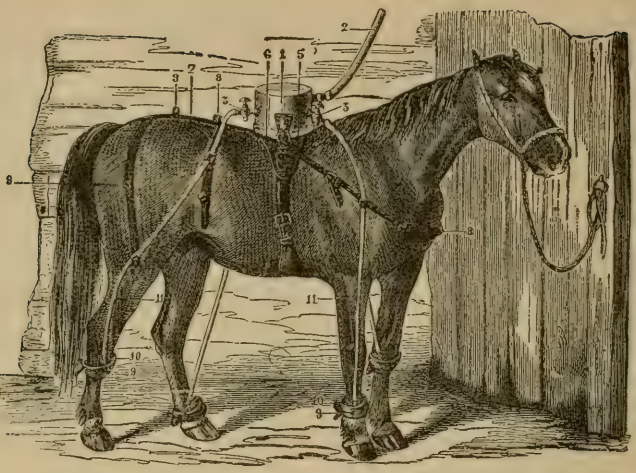


FIG. 521.—Apparatus of Mathew for Cold Water Application.

tion of salt, sulphate of iron, or alum; clay poultices mixed with vinegar have also been used. As the heat of the foot has a tendency to rise, the temperature of the liquid or of the topic used must be often changed in order to keep up its antiphlogistic effect. Baths of sulphate of iron are especially indicated in cases of traumatism.

Irritating frictions, used as derivatives, are also recommended, but their efficacy in this case is at least problematical. Irritation, when the congestion is somewhat passive, is not easy to produce. However, frictions of the hock with oil of turpentine, by the pain they produce stimulating the animal to move and not allowing him to remain in a state of almost complete immobility, may be advantageous. Blisters around the coronet are useful toward the third or fourth day, when plastic exudation or hypersecretion of the hoof are to be feared.

Frog seton is recommended by English practitioners; Gabriel says it is a sure means to prevent the separation of the nail. This seems to us unwarranted. Internally, the administration of nitre, cream of tartar, ammoniacal salts, sulphate of soda, are given; drugs which are indicated by the febril state; alkaline remedies, and principally of nitrate of potash in large doses, are administered to render the blood more fluid and increase the venous circulation. Aloes, recommended in England by Hertwig, are contra-indicated, as increasing the disease and facilitating the dropping of the foot.

It has been advised to take the shoes off. This is not only a difficult operation, on account of the sufferings of the animal, obliged to stand upon one leg, but it seems to us useless. Shoeing has not the effect supposed of it in the etiology. If it is well fitted it is not uncomfortable to the foot, while its removal from the foot, hy the hammering it requires, is always painful, and had better be avoided.

It has been recommended to pare the foot, to shorten it, to thin the sole down; but this operation seems to us in many cases superfluous. It is true that the topics will act more readily upon the living tissues underneath, but the advantages thus obtained do not compensate for the difficulty of the operation; at any rate, it cannot be done except when the animal lies down.

We shall pass silently the effect, so to speak homeopathic, that English veterinarians pretend to obtain with very warm poultices around the foot, and which have their reasons only when suppuration or gangrene is threatening. Neither shall we refer to the compression of the foot, recommended by Nanzio—a treatment which is much nicer in theory than in practice. In a great number of cases, the patient is considerably relieved by resting on a good bed, and this is especially necessary for severe laminitis when locomotion is very painful. However, in less serious cases, walking on soft ground, especially on grass, is an excellent treatment. It stimulates the circulation in parts where the blood has a tendency to accumulate, and controls the venous engorgement of the keratogenous tissue. It has been sometimes recommended to support the animal in slings to relieve him; but as with this one would expose his patient to pulmonary complication, it is better to cast him and keep him in that forced position, being careful to turn him over from time to time.

A dietetic regime, light feeding, during the first days at least, cooling drinks, rectal injections and comfortable blankets are all indicated.

One must particularly watch what takes place in the foot, and for this purpose grooves made at the surface of the foot have also been recommended; but they cannot be made deep enough, as the wall is always there resisting more or less to the eccentric forces of the deep parts.

If toward the third or fourth day there is no marked improvement, especially in traumatic founder, if even the patient becomes

worse, if the pulsation at the digital arteries is stronger, harder and more frequent, it becomes necessary at once to thin the sole down, and make a puncture upon the line of demarcation of the sole and wall with the drawing knife. Often then a flow of pus or blood, more or less altered, takes place, the nature of which indicates the progress of the disease. If it is of a grey blackish color, it is evidence that the horny tissue only is affected; while if white, it indicates a greater change. Hertwig advises this operation always, when laminitis is of long duration. He thus produces an artificial seedy toe, which is considered the mildest form of the disease. He recommends to make a deep groove upon this white line so far as there is separation of the wall from the podophyllous tissue, and then combines the treatment with the use of astringent baths of sulphate of copper. We have, on several occasions, been pleased with this treatment, combining it with the application of a blister around the coronet. It is preferable to the longitudinal grooves, or to trephining, which is sometimes recommended.

There are numerous cases, however, when, notwithstanding all these rational means, the disease cannot be arrested, and when a fatally chronic laminitis ensues. This must be considered incurable in the majority of cases. It is almost impossible to bring the foot back to its physiological condition, and, above all, to prevent the hypersecretion of the hoof which characterizes it.

However, in case of simple seedy toe, if it is the result of hemorrhage, or even of suppuration, a cure may sometime be obtained. Generally, by thinning it down, the entire portion of the wall which, at the toe, the mammæ and the anterior part of the quarters is superposed, to the keraphyllous hoof, without adhering to it, is removed. The keraphyllous hoof, also, is thinned down in its whole extent; then a dressing of hoof ointment or tar is applied so as to protect it from drying and to keep it supple. In these cases, the hoof coming down from the coronary band has sometimes united with that flowing over the podophyllous laminæ. At other times the seedy toe is only cleaned of its contents, and is filled with medicated oakum, if there is a wound of the podophyllous tissue, or with hoof ointment and Venice turpentine, the whole being kept in place by a wide web shoe. The last treatment seems to us the best, only instead of hoof ointment we employ gutta percha, melted with gum ammoniac, as recommended

by Defays. For this there must be no wound, and the cavity must be well cleaned of all substances, or even washed with ether to remove all greasy substances which would prevent the gutta percha from adhesion with the hoof. This course has enabled us to see deep seedy toes recover by the gradual growth of the foot. Hence, the indication to try to obtain an artificial seedy toe as early as possible, as recommended by Hertwig.

When there is thickening of the keraphyllous horn and adhesion with the wall; when, also, the toe is formed entirely by a deformed horny mass, the case is more serious and the treatment more uncertain. It has been recommended, wrongly, we believe, to perform the operation which consists in cutting off all the protruding hoof—to even cut off all the accidental production. To do this the rasp and drawing-knife are used, the keraphyllous mass being thrown down as much as possible. D'Arboval has also advised to make with the drawing-knife an artificial seedy toe between the internal face of the wall proper, which is preserved, and the anterior face of the podophyllous apparatus, upon which a thin layer is left. This treatment has an advantage over the other of keeping the wall intact, to render easier and more solid the application of the shoe which is to protect the foot and allow the animal to resume his work. This operation, however, is only palliative. It, however, gives great relief, especially in the first steps of chronic laminitis.

Gross has been satisfied with thinning down with the rasp the superior part of the wall, below the coronet, in a width of about four centimeters, in such a way that from one heel to the other there was only a very thin coat, which he protected with basilicon ointment. The coronet was then stimulated with a little oil of cantharides. Under this treatment, a new growth of hoof is started, not so protruding, and by paring down by degrees the hoof, a new foot was grown in a few months, less deformed and more regular.

Meyer and Gunther say that they have obtained good success with this treatment, which nearly resembles that of Gohier and Dehan, except that with those the entire wall was pared down to a thin pellicle, flexible under the pressure of the finger. Silberman advised to place around the hoof, below the coronary band, after paring it down thin, a band of steel, two fingers wide, which could be tightened by a screw placed at the heels. In this way

the secretion of the coronary band was kept under control, but not that of the podophyllous tissue.

Generally in these cases the suppleness of the hoof must be kept up by appropriate topics. It must be cut off when too thick, and a shoe must be applied sufficiently wide in the web to protect the anterior part of the sole as far as the point of the frog. This shoe must be quite hollow on the foot surface, so as to avoid any pressure upon the sole. It must be nailed on principally at the heels, as nails at the toe would not hold sufficiently. Between the shoe and the foot a piece of gutta percha, or felt or leather may be put on. Thus shod, a horse will still do long service, even in cities, and much more in the country.

When there is a wound at the sole, with separation of the part, suppuration, caries of the os pedis, which protrudes through the sole, it is advised to have recourse to a surgical operation. The contents of the abscess under the sole must be evacuated, and the sole thinned down in the entire plantar region. If the bone is carious it is scraped, the necrosed parts are removed, and a proper dressing, kept up by plates under the shoe, is put on. There are a few cases where, by this treatment, horses have been enabled to resume their work.

Often in chronic laminitis when, notwithstanding the operation and the shoeing, the horse is unable to resume his work, according to H. Bouley, the operation of neurotomy will then be beneficial. Grad is not of the same opinion. He claims that the relief is then uncertain and only temporary. Jessen and Hering say that this operation is followed very often by the sloughing of the hoof, and the animals stumble very easily. According to Braull this operation is followed by a greater growth of the hoof. If the lameness is reduced after the operation the deformity of the foot continues to increase.

Navicular Disease.

Synonyms.—*Chronische Hufgenklahme*, German; *Maladie Naviculaire*, French. This disease, called by Loisel and H. Bouley, *podosesamoideal synovitis* (synovite podosesamoidienne); by Braull, *chronic* podotrochlitis, is an inflammation of the sesamoid sheath of the horse, that Turner and some other English veterinarians were the first to describe, and which is mostly observed in thoroughbreds.

The disease is principally seen in the fore feet, and more commonly in one foot alone; sometimes, however, both legs are affected, one first, and the other following. Navicular disease of the hind feet is seldom observed.

It is accompanied with lameness and deformity of the foot, and often proves rebellious to treatment. It is followed by contraction of the heels (*encastelure*) which is itself often mistaken for navicular disease. At any rate, the affections are nearly related, whether the disease of the sesamoid sheath, first occurring, is followed by the contraction, or that the hoof, originally contracted, gives rise to the subsequent alterations of structure which constitute naviculartbritis. At present we shall only consider the deep inflammation of the podosesamoideal articulation, occurring without primitive alteration in the form of the foot.

I. *Symptoms.* — These are at first obscure. The lesion is deeply situated, and is, so to speak, concealed in the hoof, which itself, is generally at first of very limited extent. The first symptom which attracts attention is the lameness, which sometimes, indeed, seems to be merely a certain weakness of the affected leg. This lameness is at first intermittent and slight, but gradually increases. When in the stable, the animal "points," that is, the diseased foot is carried forward of a vertical line, and assumes a state of general relaxation of the muscles, with the coronet straightened and the foot mostly resting on the toe. This incomplete rest of the leg, which is sometimes kept in motion forward and backward, becomes especially apparent if the animal is moved backward in his stall. He then sets down his foot with much hesitation, and for a short time; the same thing also occurs when, in order to relieve the opposite leg, the animal puts all his weight on the diseased one. Still, a close examination of the foot fails to reveal any marked lesion; no change of form appearing, no wain at the coronary band; merely a little heat toward the heels, or on the frog, where there can also be found a certain amount of low and deep sensibility, made apparent only by percussion of the hammer upon the foot, or by the pressure with the blacksmith's nippers, principally toward the heels and the frog. According to Lafosse, the frog is often found indurated, atrophied and thrushy. If exercised, the horse frequently stumbles, and sometimes falls on his knees; he fears the pain of resting the heels on the ground, and is limited in the movements of his knee

and fetlock. If the heels are pared off, in such a manner that the frog is well prominent, and the horse becomes much heated, the lameness is increased, although at first it may have been very slight. Blacksmiths may frequently obtain the same result by placing under the foot a bar shoe, which, then resting on the frog, and not the heels, greatly aggravates the lameness until it becomes excessive. This mode of diagnosis was originally indicated by Brauell: When, after more or less exercise, the animal is left to cool off, he at once points, straightens his fetlock, and slightly flexes the knee; the leg has a trembling motion, and no rest is taken upon the heels.

There are, however, according to Hertwig, cases where navicular disease suddenly reaches a period where, in the stable, the animal avoids all resting on the heel; points constantly, and hesitates to put his foot on the ground when made to walk. It always seems that there must be some traumatic lesion in the foot, as a punctured wound or a suppurating corn; and still there is no increased heat in the hoof, and no extraordinary pulsation of the arteries of the foot.

The disease has a tendency to increase, and the animal soon becomes very lame upon being put to work, especially on a hard road or rough ground. The heat of the foot is increased principally after work, though not in proportion to the lameness. The sensibility of the foot is also more manifest under the exploring pressure of the nippers. In the stable the pointing is well marked, and the trembling of the leg gives signs of deep and persistent pain. It is only after several months of this suffering that the foot begins gradually to show a change of shape. It then becomes visibly narrowed and elongated, in a manner which can readily be detected both by sight and management. There is a general atrophy of the hoof; the periople has disappeared, or scales off; the foot becomes covered with ridges, more or less marked, but better developed toward the heels; the frog has become sunken and atrophied; the sole is ecchymosed, presenting evidences of corns; and the leg is atrophied, especially about the muscles of the shoulder.

In cases where both fore feet are affected, the animal points with either foot alternately, while seeking the desired relief for each, but the rest on either is very short. The hind legs are brought under the centre of gravity, the back is arched, and the

decubitus prolonged. In stepping out of the stable, both fore feet are held stiffly, and kept close to the ground, the animal stumbles on his fetlocks, and often falls, and one might suspect him of being weak. In walking, his shoulders seem to be rigidly attached to his body, but as he warms up the legs move more freely and his actions become less limited; but immediately on cooling off, and especially the day following one of hard work, all the symptoms reappear, with even aggravated intensity. The disease increases steadily with the lapse of time. When one, or what is more rarely the case, both hind feet are affected (Loiset has seen it occur), the animal is stiff behind; he is lame on one or both feet; he puts his foot on the toe only; knuckles at the fetlock; and presently an atrophy of the muscles of the superior regions takes place.

II. *Progress, Duration, Termination.*—The disease generally maintains a steady progress; nevertheless it very often undergoes a remission, due to the hygienic conditions in which the animal is placed; to the seasons; to the state of the atmosphere, and to other causes. It may diminish in severity, and its symptoms disappear, while in its first period, if the animals are left at rest—without shoes if possible—loose in a box, with damp bedding, or in a marshy field; or in winter, during the rainy season, while the atmosphere continues in a moist condition for a long period. It is, under these circumstances, not uncommon to see feet which had become contracted quite recover their natural dimensions. Aside from these exceptional cases of recovery, the lesion keeps on slowly destroying the tissues where it exists; the lameness remains constant, or becomes intermittent for years, sometimes after the animals have become entirely unfit for work. There are frequent complications involving the surrounding parts; sometimes a true arthritis, and besides the complete atrophy of the muscles of the shoulder, the carpal ligament becomes thickened, the tendon of the perforans undergoes the same alteration, and ring-bones and side-bones may follow. Again, however, the animal may become knuckled to such a degree that he can scarcely rest his foot on the ground at all.

III. *Pathological Anatomy.*—As we have said, the disease has its seat in the synovial capsule, formed by the small sesamoid sheath between the navicular bone and the perforans tendon, sliding upon it. At first may be observed a certain injection of the

synovia, and a darker hue in the coloration of the trochlear cartilage with the corresponding face of the tendon, the synovia becoming reddish and thick, the surrounding cellular tissue becoming, also, inflamed and infiltrated. At a later period, when the disease has somewhat progressed, there is a thickening of the walls of the capsule, which is then filled with a clear citrine serosity. There is then, a kind of hygroma, a chronic dropsical condition of the sheath. In the interior of this are also to be found fibrous bands, running from the tendon to the bone. If the disease is older, erosions are found upon the diarthrodial surface of the navicular varying in number and in size, and the tendon is roughened on its anterior face with longitudinal fissures. At times, it becomes atrophied and thin, dry and brittle; and has been found, it is said, ruptured transversely. In many cases, the cartilage covering the bone has disappeared and the bone is exposed, hollowed and affected with osteoporosis. The union of the bone with the tendon has also been found among the varieties of determination.

IV. *Diagnosis.*—This disease is at first easily mistaken for some form of rheumatic affection. Where pain is the main symptom it is easily detected, but where there are no other signs of inflammation, it is just the lack of proportion between the intensity of the lameness and the serious symptoms, such as the absence of heat; of special sensibility; of pulsations in the digits, which distinguishes navicular disease from other affections of the feet. The error with contracted heels is easier, as here the change of form of the foot being primitive, at once attracts the attention of the practitioner; while this alteration in the foot is absent in naviculartbritis at the outset of the disease.

V. *Prognosis.*—Generally, it is unfavorable, as most commonly the veterinarian is called only when the disease has already made serious progress and passed into the chronic stage; and again, because of the difficulty of reaching the disease by reason of its peculiar location.

VI. *Etiology.*—To properly understand the etiology of this disease, one must bear in mind the part played by the anterior legs in the action of locomotion. Columns of support more than of impulsion, it is their office to sustain the weight of the body when it is thrown forward by the extension of the hind legs. The reaction of the ground is first felt at the shoulders, through the

muscular slings which attach them to the trunk, but it is partly diminished in the scapulo-humeral joint, which closes, notwithstanding the resistance of the muscles implanted on its apex. The remaining force is transmitted to the vertical column, represented by the union of the radius, the carpus and the metacarpus. Reaching the digital region, this force is there decomposed. Part of it, passing on the phalanx, loses itself and disappears in front of the horny box of the foot, the other being thrown upon the flexor tendons, and finally upon the perforans, which distributes it to the posterior parts of the foot, and to the navicular bone. It must be observed that in this complex action of decomposition of the shock, the os sesamoid, though pushed from before backward by the os coronæ is, however, supported by the resistance of the perforans tendon. Consequently, both the bone and the tendon are pressing upon each other, when the feet are placed on the ground, throwing the body forward by the impulse of the hinder parts, and thus press powerfully against each other.

When this pressure takes place in an animal going full speed, and a good and high stepper, it may commence by becoming merely a slight confusion, but, if often repeated, the result may be some lesion upon the corresponding surface of the bone and of the tendon, or of the synovial which facilitates their movements. But the energy of action in the animal cannot be considered the only producing cause of these lesions, as a vice of conformation in the foot, a want of elasticity in its posterior parts where the resisting power is diminished, may also produce it. The disease, then, is observed in animals whose plantar cushion, covered by a small, dry and atrophied frog, is itself badly developed, from being compressed between the bars, which are more vertical, or the heels, which are more contracted; all these being conditions which diminish the flexibility of the back of the foot.

Two principal causes, then, co-operate in the genesis of navicular disease, and are almost always present in animals thus affected. On the one hand, it will appear among well-bred animals, especially those of English breeds, those from Hanover, Mecklenburg and Normandy, which will be more affected. Loiset and Lafosse, however, have seen it in common breeds, in animals with flat feet and soft horns. Lafosse says he has seen it in mules. But besides this influence of the breed, there is the effect of what

we may denominate the hygiene of the foot; the too dry bedding, certain wrong modes of shoeing and all the predisposing causes of contracted heels. Let us add also, as a cause, the effect of changing the animals from marshy fields, where they were walking on soft, damp ground, to stables with dry bedding—a cause commonly present in horses transported from northern Germany to the south. Hard work and excessive exercise are also causes of this affection—for example, jumping fences with a heavy rider, slipping in steeple-chases, racing, a sudden stop on the fore feet, especially on stony, hard, frozen or rough ground. All these are fruitful cases of navicular disease.

Traumatic causes, such as punctured wounds, involving the sesamoideal sheath, are also productive causes which may originate navicular disease. We do not believe in internal causes, nor admit, with Loiset, that visceral inflammation, sudden arrest of perspiration, especially of the lower part of the legs, can produce the disease. We should rather anticipate that these metastases would affect more the more important serous structure. Neither can we admit, with Lafosse, that this affection can also follow a sudden arrest of the milky secretion.

VII. *Treatment.*—We have seen, in speaking of the terminations of these lesion, that in certain peculiar circumstances which may be accounted favorable to the return of the elasticity of the foot, a spontaneous recovery is possible. This leads us to the measure of the prophylactic means proper to be used; and it seems evident that by a better hygiene of the feet, by rational shoeing, sometimes educating young horses only gradually to fast work, one may in many cases avoid navicular disease.

While it is in its first stages, one may, with care and patience, sometimes relieve the patient. In this case, absolute rest is counter-indicated, but on the contrary, moderate exercise, upon even and not too hard ground; or, if the lameness is great, walking exercise only, at a moderate gait. The absorption of the serosity present is made easier by a little exercise than by absolute rest. Bleeding from the toe, or the veins of the affected legs, is also, at least, superfluous, the disease becoming chronic almost at the outset. It is also a good practice to shoe the horse, and above all, to remove the shoe frequently. The best shoeing is that which allows for the natural expansion of the hoof. The Charlier shoe has proved useful, while the bar shoe, which is heavier, and

presses upon the frog, is counter-indicated. It is important to encourage the suppleness of the hoof by proper ointment, especially the application of glycerine, and to have under the feet a bedding always slightly damp and soft. The bedding of moist sawdust is very convenient; we prefer it to poultices, and even to the tepid alkaline baths mentioned by Hertwig. At times, at intervals of about eight days, and then during two consecutive days, a good friction with blister ointment above the coronet is advantageous, as well as one with Lebas' ointment. English practitioners prefer salines; the better treatment would be to turn the animal to grass. Brauell advises iodine internally, and says he has found it work well. Others recommend diuretics. Setons in the shoulder or chest seems to us inexpedient. We prefer the administration of a purgative ball every eight days. Sewell and Brauell advise a seton, running from the hollow of the coronet through the plantar cushion, a little behind the tendon of the perforans, and within a short distance, therefore, of the diseased capsule, making its exit at the anterior third of the frog. This drain is to be maintained for two, three, and even four weeks; Sewell, Brauell, Hertwig, and several other veterinarians, English especially, claiming much benefit from it. This seton is introduced by means of a curved frog seton-needle; it has been used but little in France. Bruner has recently proposed the puncture of the sesamoideal capsule with a trochar, introduced into the hollow of the coronet, an operation only practicable if the serous collection can be felt outward. After the puncture, he recommends an injection of iodine.

Lafosse proposes after the removal of the sole, the transversal incision of the plantar cushion, with removal of a part of it, down to the tendon, following the axis of the sesamoid; then the cauterization of the bone and its cartilage, in imitation of what is sometimes done in punctured wounds of the foot. Brauell recommended as a useful surgical operation, the section of the perforans tendon in the metacarpal region, in order to prevent friction against the sesamoid groove, and to allow an easier adhesion between the tendon and the bone. But it is to be feared that this section, supposing that it proves successful, might so weaken the tendon as to render the animal unfit for fast work.

If navicular disease should be accompanied with deviation of the wall, and contraction, true or false, the treatment will be that

of this affection in its simple form. An operation, often recommended, has been that of neurotomy, upon the posterior branches of the plantar nerves, repeated at intervals of at least fifteen days, in order to remove the lameness wholly, without entirely depriving the foot of the sensibility of feeling. Berger, Brauell, Bouley, Gross, Mandel, and others, have obtained real success by it; but it is attended with serious dangers; at any rate the benefit is not of long duration, or about one year. The animal then stumbles more readily, and is more exposed to traumatic lesions, etc., and it is probable from this cause that double neurotomy is seen to be followed by softening of the deep parts of the foot, suppuration, sloughing of the foot, while the animal has previously shown no signs of pain. Consequently, neurotomy is an operation which finds its application only in peculiar and exceptional cases, and animals thus operated upon remain fit for light work only.

QUITTOR.

Synonyms.—*Fesselgeschwur*, German; *giarda*, Italian; *gialarrs*, Spanish; *javart*, French.

A name of unknown etymology, by which old hippiatrics designate various affections of the inferior regions of the legs of the horse, donkey and mule, and even of bovines. These possess the common character of a degeneration of a portion of the tissues, that is expelled by the efforts of nature under the form of a slough (*bourbillon*). There is a softening of the mortified structures, and an elimination by suppuration. In several old works, these sloughs are called quittors (*javars*), and this name has been extended to the disease itself.

This name having been preserved by use, notwithstanding the efforts of Vatel in opposition, we shall also employ it, and with Girard, recognize: 1st. The *simple* or *cutaneous* quittor, which is only the furuncle which occurs in the thickness of the dermoid structure nearest to the coronary band. 2d. The *tendinous quittor*, which greatly resembles the felon of man, where a portion of the sub-cutaneous cellular tissue, and of a tendon sloughs out. 3d. The *sub-horny quittor*, the furuncle of the cutidura of the coronary band itself, the slough involving the superior portion of laminated tissue. 4th. The *cartilaginous quittor*, or the limited caries of the lateral fibro-cartilage of the os pedis, and which old writers compounded with the horny quittor. We might join to

those the furuncle of the frog. We believe it useless, at present, to enter upon a general consideration of quittor, and will proceed to examine the pathological phenomena presented by each variety.

A. Cutaneous Quittor. — This is a simple furuncle of the coronary region of the foot, in that part of the dermis nearest to the coronary band, having, however, a special character on account of the extraordinary thickness and inelasticity of the dermis of the region it occupies, the result being a kind of strangulation of the inflamed tissue beneath, and a very painful compression. It is through error that some authors have designated by the same name, the furuncle of the canon, of the fetlock, and of the coronet.

The hind feet are more subject to it than the fore, and it is more frequent at the heels, at the flexure of the fetlock, though it is also observed on the sides and front of the coronet, in which case it is much more painful. Cutaneous quittor has also been observed in bovines, where, however, as we shall see as we proceed, it is generally complicated with the tendinous variety, and becomes a true felon.

I. *Symptoms.*—Cutaneous quittor is characterized by an inflammatory tumor or swelling, warm, painful, and tense, of the coronary region of the foot, the color of the skin being but little changed, if it is dark, but if the skin is light then the redness is well marked. This swelling is accompanied with a diffused œdema, extending to the fetlock, or even to the hock. We often find angeioleucites, or rather what we call leucophlegmasiæ. The lameness is generally extreme, and the animal frequently can scarcely rest on the diseased leg. The pain is sometimes so great as to induce general fever and loss of appetite, and the animal becomes dull and depressed. After acquiring certain dimensions, the tumor shows a tendency to soften at its summit, its base, however, remaining hard for a considerable time. Rising more and more, it soon ulcerates at a point from which flows a small quantity of bloody pus, followed by the appearance of the slough, (*bourbillon*). An abscess is now formed in the tumor, which, as it opens, carries with it a portion of the skin, sometimes limited, at others measuring from four to ten centimeters, and there is a slough formed of the subcutaneous cellular tissue which separates by the suppuration with the portion of dead skin. This comes

out by degrees. It is still adherent by its base and cannot be pulled out with the forceps unless by tearing and with acute pain, and this is often followed by slight hemorrhage. A few days later it will, however, become entirely loose, and in its place there will remain a cylindroid open cavity extending through the tumor, from its summit to its bottom, and from this a deep wound results, followed by a sero-bloody secretion, mingled with pus. As soon as the slough has taken place, or when it begins, the lameness subsides, as well as all the other phenomena of the pain. The wound heals up rapidly if there is no complication.

Cutaneous may easily be complicated with tendinous quittor if the disease or process of sloughing of the mortified tissues extends to the tendons or ligaments of the region involved. This complication is specially common in bovines, where cutaneous quittor generally gives rise to more swelling and greater suffering than in the horse.

The quittor has quite a rapid progress, and may last from eight to fifteen days; very seldom longer. At times, it seems to be a single furuncle; at other times, there are several existing together. Often again, they come in succession, the first one treated being soon followed by others. This is said to take place principally when the diseased part remains exposed to the action of irritating substances, and relapses are prevented by protecting the part from the effects of these occasional causes.

II. *Pathological Anatomy.* — It is an inflammation of the very abundant sub-cutaneous cellular tissue of the region, spreading from a starting point; the inflamed tissues are mortified and becomes gangrenous, and by a process of suppuration, the economy attempts to eliminate them. The slough represents more particularly the inflamed cellular tissue, which is thickened, and which has become filamentous and hard and much impregnated with purulent serosity.

III. *Etiology.*—Contusions of the region, bruises and punctured wounds are quite frequent causes of cutaneous quittor, but it may also take place without evidence of determining causes. Mud, manure, urine, all filth in which animals have to walk or remain, are also considered as causes. For this reason the disease is more common in the fall and winter, on account of the action of cold at times, and frozen mud. It is also more frequent in cities than in the country. Ray observes that the mud of cities is al-

ways more irritating and contains mineral substances, especially lime, alkalines, and salts, and other substances. The gutters of some industrial establishments have also a direct irritating action. D'Arboval has observed that the mud of places where mineral springs exist, is more irritating, as also are calcareous soils, where cutaneous quittor is more frequent than in any other. Common, large horses, notwithstanding their thick skins—or, rather on that account and on account of the hair which covers it—are more commonly affected than private horses. Towing horses are much more exposed to the disease than those otherwise employed.

IV. *Treatment.*—As a first direction, during the course of the treatment it is always a prudent rule not to work the animal and to keep it in the stable, the feet being kept dry on a good bedding. An internal treatment is seldom necessary to control the general symptoms; if any is required, ordinary salines will generally be sufficient. It is necessary to assist the process of suppuration of the abscess by emolients, warm baths, poultices of flaxseed or of marshmallows, with melted lard, applied quite warm, or by the application of a mixture of honey and bran or flour. We have applied a coating of blister ointment to the tumor, covered with a warm poultice; the maturing effect is then very rapid. It is often necessary to lance the tumor to reduce the pain and prevent the mortification of a large piece of skin. This operation is recommended by D'Arboval and H. Bouley, and is specially indicated when the tumor is much developed. It is then important to incise in the entire thickness of the dermis and to a sufficient length, and if necessary to make severel parallel incisions which will give rise to a copious flow of blood. In this mode, the parts are relieved, the pressure of the tumefaction is reduced and the gangrene diminished, if not entirely prevented. It is necessary—and we insist on this point—to incise so deeply that the tumefied skin is divided in its entire thickness. We have seen blacksmiths thus operate by the introduction of points of cauterization in the summit of the abscess; but this mode, though facilitating the sloughing of the strangulated part and reducing the compression, ought not to be preferred to the incision with a sharp instrument—cauterization is more painful.

When gangrene exists and the abscess is open, the incision is certainly less efficacious than at the outset, but it is not for that reason useless, as it relieves the pain and prevents excessive com-

pression. We do not by it attempt to loosen the slough, which it is advantageous to have detaching loose itself when it holds only by its base. If the abscess, once formed, is slow to ulcerate, making a point of cauterization is a good way to stimulate the escape of the matter of the slough. This mode of opening produces in the part an increase of vital action and forms a sore of benign character, which falls off by the effect of the suppuration formed underneath, and which is nearly always followed by a comparatively speedy recovery. To obtain this radical cure, it remains to continue the use of the ordinary means to facilitate suppuration and bring on resolution. If the wound is pale and covered at the bottom with large granulations, it must be dressed first with basilicon ointment and afterward with alcoholic liquids, as spirits of camphor, tincture of aloes, or simply an aromatic infusion; at times, baths of sulphate of iron, with a little sulphate of copper, are indicated; or, when the wound has become red, the granulations vascular and of healthy character, a simple dressing of œgyptiacum ointment, diluted in vinegar, is enough. If proud flesh develops itself, it must be cut off. It is important to have the wound covered with a protecting dressing, which must be renewed daily if the suppuration is very abundant, or it may sometimes be left on for two days.

B. Tendinous Quittor. — Synonym: *Hornwurne* (Germ.) — It is the nervous quittor of hippiatres, and the analogue of the felon of man. It is again a furuncle, different from the preceding, only because instead of being limited to the skin and subcutaneous cellular tissue, there is caries of a portion of the tendons (especially the flexors), or of the ligaments of the region, and also, at times, necrosis of the bone with synovitis and arthritis. By extension, though we think, improperly, the name has also been given to the felon of the region of the cannon, while the application ought to be confined to that of the digital region, situated in the fold of the fetlock.

The quittor may be superficial or deep-seated when it affects only the subcutaneous cellular tissue, uniting the skin to the tendons, or where the inflammation extends to the phalangeal sheath, and the pus accumulates into it. Differing from cutaneous quittor, this form, generally less common, is more frequently seen in the anterior than the posterior extremities. It may also be seen in cattle.

I. *Symptoms.*—The first symptom is an excessive lameness, manifesting itself even where no visible change exists in the affected leg. The animal evidently suffers great pain, while his actions do not aid us in localizing it accurately, though the foot is always examined as being the probable seat of it, the animal raising it more rapidly than the other from the ground, and resting on it with much caution and hesitation. After from two to five days, a phlegmonous tumor appears at the coronet, above the heel. It is extremely warm, and much more painful than that in cutaneous quittor, the hoof and the skin preventing the free development of the inflammation by strangulating it. The foot almost ceases to rest on the ground, but is flexed and raised from it, feeling in the parts being very painful. The swelling of the leg extends to the fetlock, or to the cannons, and even to the knee. The animal has more or less fever, and when there is a deep quittor, he loses all his appetite, and ordinarily lies down and continues in the recumbent position.

Generally, much time is required for the phlegmon to assume the character of an abscess, as the slough, being in this case no longer formed by the cellular tissue, is slower to define itself. This process of suppuration is not so well localized; there is, on the contrary, a kind of deep abscess, which probably becomes complicated by the resistance opposed to the ulcerative inflammation by the aponeurosis of the sheath and the thickness of the skin. However this may be, it is always very difficult to recognize the presence of one or several of these abscesses, even when they form in the subcutaneous cellular tissue, and so much the more if the purulent gathering is deeply seated.

After the opening of the abscess and exfoliation of the slough, either with or without the dropping of a portion of the skin, there does not remain the simple wound of the cutaneous quittor, but on the contrary, a persistent fistula, running down a necrosed point of the tendons or of the fibrous sheaths. At times, almost from the outset, we may observe in the fold of the coronet numerous little pimples, which terminate in as many deep fistulæ, from which ooze a more or less thick humor, fœtid, puriform and bloody. In frequent cases, the disease in unaccompanied with suppuration, and there is a swelling, more or less hard, with a gradual diminution of the pain and other inflammatory symptoms. A more frequent complication is the suppurative inflammation of

the tendinous sheaths, or even of the digital articulations. There may also be a diffused gangrene with separation of the hoof and purulent infiltration under the horny box—periostitis, and caries of the cartilage. This is the deep tendinous quittor in the most severe form. In this last case, especially if there is an accumulation of pus in the tendinous sheath, the tumor is very painful, the slightest touch giving rise to the manifestation of extremely acute suffering, the hoof being constantly raised from the ground. The fever is violent, there is a complete anorexia, and the exercise of all functions is more or less disturbed. The compulsory resting upon the healthy legs may give rise to swelling of the hocks, and even to laminitis.

In cattle, tendinous quittor becomes more painful than in the horse, and is always accompanied by a swelling which may extend to the knee. Rumination stops, and the animal endures great anguish. The slough is followed by a wound of varying depth, which often exposes the diseased articular surfaces of the phalanges. If this remains too long, the pus may affect the interdigital ligament, complicate the disease, and even make it incurable. In this case, the amputation of one of the digits may sometimes be performed.

II. *Progress, Duration and Termination.*—The duration is generally protracted; the disease often gives rise to chronic lesions difficult to remove. This will be easily understood, if we remember that the region affected is composed, between the skin and the bones, of synovial capsules, ligaments, tendons and aponeuroses, more or less cellular tissue, and of very strong nervous ramifications. If the disease is not very deeply seated or unilateral, complete recovery may be looked for; but if there are chronic lesions, if the articular surfaces become affected; especially if particles of bones are sloughing, if the animal recovers it will be but imperfectly, and it will usually be accompanied by anchylosis of the joint, and diffused gangrene is also a complication to be looked for.

III. *Diagnosis.*—We said at the beginning that tendinous quittor is a very obscure disease; the lameness is very great, but not characteristic; in proceeding, we referred to the acute local pains at the side of the tendinous cord of the cannon, the inflammatory swelling, the increase of local pains, and the general reactive fever.

IV. *Prognosis.*—It is a very serious disease, on account of

the possible complications and sequelæ. The loss, or the deformity of a phalanx, which are sometimes among the sequelæ of the felon of man, are in him accidents which never give rise to serious complications, or are quickly forgotten, while in the horse such complications are equivalent to the death of the animal.

V. *Etiology.*—The causes are the same as those of a simple quittor, which is complicated with the tendinous kind; this is also observed after the subcutaneous abscesses, frequently resulting from bruises, or even from punctered wounds. It is most commonly met with in low-bred horses, and Fisher says that it is more frequent, and less malignant, in young than in adult animals; according to this writer, it is a common manifestation of distemper. Irritating muds favor its development in the same manner in active as in simple quittor. It often appears without appreciable causes.

VI. *Treatment.*—When tendinous quittor is superficial, it requires about the same treatment as the simple kind, except that, in this case, the counter openings must be made early to prevent the sloughs, migrations of the pus and the gangrene. The surgeon must not forget that the inflammation in this affection must ordinarily terminate by suppuration, and he must bear in mind that there is a possibility of the modification of the inflamed cellular tissue, and that the mortified portion of that tissue must slough out, as their presence, too long continued, may be very dangerous. The general indication is to prevent, as much as possible, the accumulation of the pus, an indication which will be best fulfilled by making openings for its escape, even before the formation of the abscess. As the tissues which surround the pus are very resisting, nature will not be able, or if so, only with great difficulty, to effect the expulsion of these matters. It is for this reason that it is necessary to assist her operations by making an opening for the escape of the pus and of the slough. The operation is without danger; but if it is not performed in good time, lesions will be likely to spread, the disease cease to remain a local trouble, and the life of the animal become compromised.

It is also more necessary to make an opening when the purulent secretion is established, for in this case it is important to avoid delay and to facilitate its escape. A simple longitudinal incision, four or five centimeters long, is sufficient, when the collection lies immediately under the cutaneous organ. This incision

must involve the whole thickness of the skin, as far as the tendons, and should be made in the middle of the coronet region, as near the foot as possible. It gives rise to an abundant hemorrhage, which relieves the part, and warm poultices and baths, to accelerate the suppuration, are then indicated.

When the product of suppuration has passed in the tendinous sheath, a longitudinal opening of this part towards the most dependent points, is indicated. To do this, a canulated directory is introduced to guide the bistoury; when the incision is made, the pus flows freely, and by this mode the large blood vessels and the various ligaments of the region are avoided in the operation.

Notwithstanding the incision, or if the suppuration had already accumulated before it was made, the pus may also accumulate in the pouch formed by the tendinous sheath behind the tendons. It is then very difficult to prevent its collection in those deep parts, and it may extend to the small sesamoid. It is because the pus cannot run toward the skin that it filtrates along the tendon. It is only by pressure and by injections that the indications presented can be fulfilled. After making free incisions, one may try by pressure to remove the pus accumulated between the tendons and their sheaths, following it by cleansing injections, which must be repeated as often as possible.

The wounds which remain after the slough, in the superficial tendinous quittor, and that which follows the opening of the simple or multiple abscesses when it is deeper, are always characterized by the presence of fistulas running down to some necrotic spot of the tendons or of their sheaths. For these, an injection is recommended of tincture of aloes, tincture of iodine, and sometimes of Villate's solution; lately, dressings with petroleum or phenic acid have been used. Phenicated baths, those of sulphate of iron and lotions of permanganate of potash have also proved useful. At times, when the fistulas are persistent, it is necessary, after enlarging them, to have recourse to actual cauterization with a pointed cautery introduced, while at a white heat, down to the bottom of the tract. A general dressing of the wound follows, with tincture of aloes, sometimes with egyptiacum. The dressings should be more or less frequent, according to the quantity of the pus discharged. We must dress it until the wound is entirely healed, and it must, moreover, be carefully watched for fear of another infiltration of pus, or the formation of other fistulas.

Superficial cauterization is necessary in order to remove the induration and swellings likely to follow, and to stimulate the resolution. The action of the firing may be stimulated by blistering, or by an alterative ointment of iodide of mercury, of sulphur, etc.

C. Sub-Horny Quittor.—This is the inflammation of the superior part of the keratogenous apparatus of the cutidura; or even of the superior parts of the sensitive laminæ. This quittor is, therefore, located under the horny box, and is more like the cartilaginous kind, which old hippiatrics, and especially Solleysel and Garsault, describe with it. It generally takes place on the quarter, and more seldom at the toe, or at the mammæ. Sometimes it is observed at the heels, but it is then of small consequence.

I. *Symptoms.*—The lameness is very great. The animal walks on three legs, and there is strong reactive fever, due to the excessive pain—this form of the disease being more painful than the others, in consequence of the pressure of the horny structure upon the inflamed tissues. At the origin of the nail a warm and very painful tumor is found; the foot is hot and the hairs staring on the site of the injury. If the disease has existed for some time, there is a separation of the hoof at its origin, due to a sero-purulent exudation, and under the hoof suppuration and mortification of a more or less extensive portion of the coronary band, or of the laminæ will be found. The suppuration which there exudes varies, being in rare instances blackish, as it is usually found in traumatic injuries of the hoof; or, again, it is white and unctuous, with the odor of decaying cheese; while more commonly it consists of a bloody or greyish matter, mixed with pus.

If the mortified portion is not deeply seated, so that the slough can take place readily, the quittor is quite simple, since as soon as it has dropped off there is a well marked improvement. The pain then ceases almost instantaneously, and the wound at once progresses toward cicatrization. But it is not rare, even when the mortification is somewhat superficial, to find the sub-ungueal suppuration extending so that the matter runs under the hoof, producing at times more or less serious fistula, or a separation of the sensitive and insensitive laminæ. Girard says it has been seen to extend downward to the sole, and to separate it from the velvety tissue. The deep, sub-horny quittor may be complicated,

forward, with necrosis of the tendon of the extensor muscle; with the inflammation of the joint; with caries of the os pedis, and even to assume the cartilaginous form of the disease by its extension to the cartilages of the foot.

After the recovery of the sub-horny quittor, if the coronary band has been mortified in its entire depth, the foot may present permanent longitudinal fissures, or seams, or transversal grooves, presenting evidences of the existence of a cicatricial tissue when the quittor was in progress.

II. *Prognosis.*—The gravity of this quittor depends upon the depth of the disease. When superficial and affecting only the surface of the tissue, it is easy to cure, but if deeply seated it is more serious, on account of the possibility of complications.

III. *Etiology.*—Bruises and violent blows are the ordinary causes of sub-horny quittor. It is commonly due to overreaching, or to the wounds occurring when animals are wearing long caulks, as in winter. The irritating effect of frozen mud has also been admitted as a cause.

IV. *Treatment.*—The superficial quittor requires a simple treatment. Emollient baths and maturating poultices are then indicated. It is a good plan to thin the wall with the rasp or the sage knife over the whole extent of the furuncular tumor to a height of about two fingers. A compress of chloroformed oil, while it alleviates the pain, is also indicated to soften the wall. It frequently becomes necessary to puncture the tumor, but we prefer to cauterize it with a pointed iron, following the cauterization with a poultice of honey with Venice turpentine or camphor. Some authors recommend astringent baths, as oak bark, or of sulphate of iron. It is often the case that after some interval following sloughing of the *bourbillon*, the wound continues to discharge a liquid secretion, which is an evidence that there is a tendency to accumulation of matter toward the lateral cartilage, or under the wall, in the laminæ; or that there is some carious spot existing. In the first, if probing horizontally, a cavity is detected, it is convincing evidence that a cartilaginous quittor is in course of development; in the second case, the pressure and collection of the matter increases the inflammation of the laminæ, separates the wall, and complicates the disease, necessitating the *operation of the sub-horny quittor.*

The removal of the portion of the hoof which covers the lesion,

must, however, include more than the purulent center, so that the diseased tissues may be well exposed and the suppurative process detach them readily. This removal, always proportioned to the internal lesions, is made either lengthwise, following the direction of the horny fibres, or crosswise. In that case, it will attack only a portion of the wall toward its point of union with the skin. This latter method, it is true, requires less cutting, but it has several quite serious objections and often necessitates a second operation. Even in cases where the growth of the granulations can be controlled, and where a good return of the horse is obtained, the horse only recuperates its perfect integrity by the slow growth downward of the wall. In some circumstances the operation is completed by the removal of a portion, or even of the entire mass of the sole, when it is separated from the velvety tissue.

The removal of a portion of the wall must be accomplished in the manner which will be indicated for cartilaginous quittor, in carefully avoiding the injury of the coronary band and of the podophyllous tissue. The diseased tissue being exposed, all that is of bad appearance is removed, the carious portion being freely taken off. An ordinary dressing of oakum with diluted alcohol, or any other drug, kept in place with a light shoe or slipper, entire or truncated, as the case requires, is then applied.

As for all wounds of the foot, the dressing needs only to be changed when the pus accumulated under the oakum, or other peculiar conditions indicate it. It is true that changing the dressing is an effective means of cleansing the wound, but it has the inconvenience of also irritating it, and especially at the beginning may tend to interrupt the natural process of repair. It is of advantage, after the first dressings, to change them as infrequently as possible. In this way hemorrhages, which may always be looked for, are avoided. This is a point of the first importance. It has been proved that even in operations where a portion of the wall has been removed, a dressing left on for from fifteen to twenty days without removal, was followed by rapid recovery, the new hoof growing under the oakum without suppuration. It is useless to probe or wipe out the surface of the wound. On the second dressing, that is, after a few days, the parts begin to be covered with numerous white points, which are so many rudiments of hoof. These, which at first are soft, white, and isolated, gather together by degrees, and first unite into a thin layer, soft

and yellowish, which becomes hard and thick; it is the hoof secreted by the laminæ, which, little by little, unites with that coming from the coronary band. Excessive granulations or proud flesh are removed in the ordinary way.

D. Cartilaginous Quittor.—*Hufknorpelfister* (German)—(*improperly called sub-horny quittor*, by Lafosse, Jr., *coronary* quittor of Vitet; *fibro chrondritis* of the third phalanx, by Vatel; sub-horny cartilaginous quittor of Girard; quittor proper of Delwart). This form of quittor is peculiar to solipeds, they being the only animals which have fibro-cartilage on the os pedis.

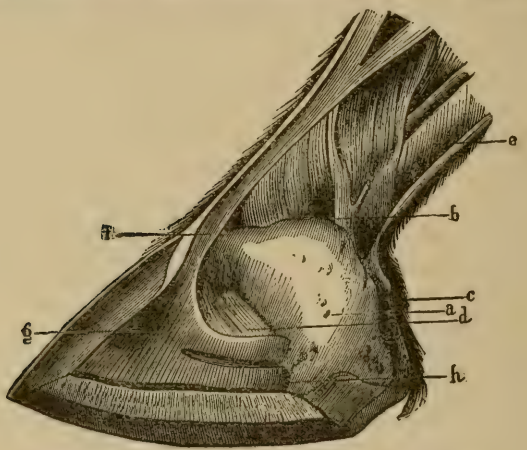


Fig. 523.—Cartilaginous Apparatus of the Hrrse's Foot.

a.—Lateral fibro cartilage. *b.*—The superior border. *c.*—Its posterior border. *d.*—Anterior lateral ligament. *e.*—Flexor tendons. *f.*—Extensor tendon. *g.*—Os pedis. *h.*—Retrorsal process.

These fibro-cartilages (Fig. 523) are two pieces, which, with the plantar cushion, complete the os pedis and form the base of the heels, each representing a piece flattened sidewise, a parallelogram in shape, and extending posteriorly to the coffin bone. Their external face is convex and pierced with foramina for the passage of veins, and slightly overlies the surface of the bone of the foot. It is separated from the skin by a very rich vascular plexus. The internal face, concave, is hollowed by vascular grooves, and covers (forward) the articulation of the foot and the cul-de-sac of the synovial sac which protrudes between the two lateral ligaments of that joint. Downward and backward it is united to the plantar cushion, either by continuity of tissue, as

near the inferior border, or by fibrous bands running from one to the other. The superior border, either convex or straight, is thin and separated from the posterior by an obtuse angle in front of which it presents a deep notch for the passage of the blood vessels and nerves. The inferior border is attached, forward, to the basilar and retrosal processes of the os pedis. Behind this it reflects inward, to continue to the inferior face of the plantar cushion. The posterior border, oblique, backward and downward, is slightly convex and unites with the preceding. The anterior border, oblique in the same direction, is more intimately united to the anterior lateral ligament of the articulation and can be separated from it only by artificial dissection. It sends upon this ligament and upon the anterior extensor of the phalanx, a fibrous extension, which unites with that of the opposite side.

In their structure, the fibro-cartilages comprehend a mixture of fibrous and cartilaginous tissue, a mixture which is far from being homogeneous and even in the various parts. The more it is examined forward and near the base, the more its substance is seen to resemble that of cartilages proper, being white, flexible, brittle, and homogeneous. Toward its posterior part it loses its character of homogenity, becomes less brittle and presents in its thickness a greater amount of fibrous texture. More posteriorly again, the fibro-cartilaginous structure is more marked. By close attention it seems to show cartilaginous nuclei, isolated, and surrounded with an entirely fibrous substance; and again, at its posterior extremity it becomes fibro-greasy with much cellular tissue and unites with the plantar cushion. The vitality of the cartilage is in inverse ratio with its density and consequently is greater in its posterior part than toward the base and its anterior extremity. This fibro-cartilage may easily and more or less completely become ossified; old horses are those which most commonly present this condition, and draught horses are more subject to it than those used to the saddle. It assumes various forms. At times it occupies the entire extent of the cartilage, and at others only at its base; sometimes the external surface is ossified, while the internal remains in its normal structure; then again, the ossification exists only anteriorly while the posterior is cartilaginous, and it more rarely happens that the process consists in bony lamellæ, which, starting from the base, spread toward various points of its circumference.

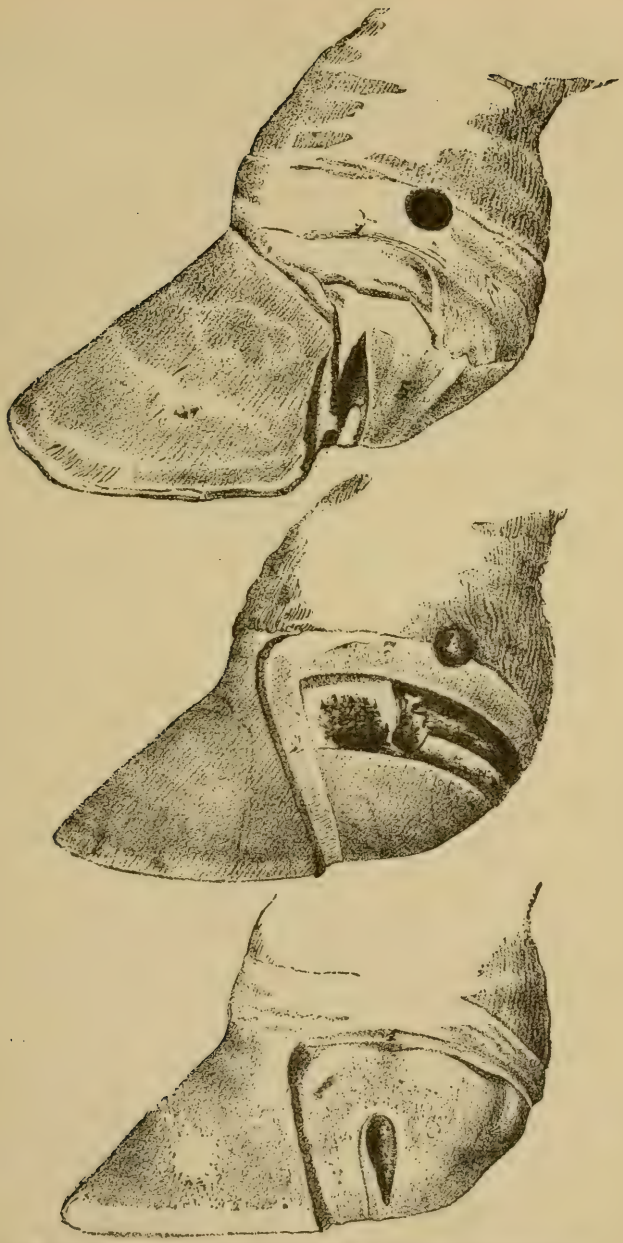
These fibro-cartilages are generally more developed in the anterior than the posterior extremities. They also present, in one foot, this slight difference, that the internal stands a little higher than the external.

Cartilaginous quittor is a serious affection, characterized by the partial caries of one of the fibro-cartilages; it is a partial gangrene whose character is to slowly spread into the cartilaginous structure upon which it starts. To be treated with success, it requires a very regular attendance, and often an operation, which consists in the removal of the cartilage. Sometimes this operation is indispensable, and its study is interesting, especially because, though not as commonly performed as at the beginning of this century, it is one which requires a high degree of surgical skill for its success.

I. *Symptoms.*—A division has been made of an *acute* and *chronic* form of this disease. Under the first name, is considered the earlier period of the affection, that in which there is inflammation of the cartilage and painful swelling of the part, and when the caries or necrosis of the fibro-cartilage is not yet established; or if there is a wound, when it does not yet granulate, and the suppuration, if it exists, is very slight. Chronic javart would be that in which the partial and progressive mortification of the fibro-cartilage exists; for, as Renault has said, it is the ordinary termination of fibro-chondritis.

When free from serious complication, the disease is generally accompanied with but little lameness; sometimes there is almost none, and animals can be kept at work, especially at a slow gait; but if made to trot, the horse will show lameness. It is especially when the quittor exists in the posterior parts, that the inflammation and the pain are not excessive, because there is then an abundance of soft, fatty tissue. But when the caries is more forward, and is situated more deeply, in a point nearer the articular surface, the lesion then affects the fibrous tissues and the pain is greater. It is sometimes excessively acute.

Upon the lateral part of the coronet, toward the heels or the quarters, more or less tumefaction appears, more or less painful, according to the duration of the disease, and in this case more or less indurated. In the centre there exists a granulating fistulous wound. There are one or several fistulæ (Figs. 524, 525, 526) whose openings show granulations, bleeding easily, their course



FIGS 524, 525, 526.—Cartilaginous Quittor. Various Spots of Necrosis.

always forward, running at times in straight lines, at others irregularly. The tracts frequently communicate and discharge a granular, serous and thin pus, of pale greyish color, generally odorless, or slightly sanious, containing greenish particles, which are but pieces of diseased fibro-cartilage. The pus dries up on the surface and adheres to the hoof and to the hair, and sometimes irritates the surface of the skin. If one of these fistula become cicatrized, a fluctuating tumor soon appears, close to it, which rapidly ulcerates, and then gives rise to another fistula. If the disease is quite old, the hoof of the quarter corresponding to the necrosed cartilage, loses its perioplic band, becoming rough, ramy and cracked, and the wall is thickened, because the irritation of the coronary band has stimulated its growth. This change in the condition of the wall varies with the length of time the disease has existed, and consequently, it indicates its duration quite accurately, when one remembers that the hoof grows downward about one centimeter in each month.

When cartilaginous quittor is the sequelæ or complication of the suppurative corn, of a punctured wound by a nail of the shoe, or any other affection of the foot, the symptoms proper to these diseases are first observed, though the lameness is greater, and the fistulæ of the quittor is evident. Often, however, this, instead of being external and on the coronet, is situated at the inferior part of the foot, at the internal face of the inferior border of the wall, upon the sole, and sometimes connected with the wound of some of those affections of the foot.

II. *Pathological Anatomy.*—When one examines the cartilage affected with the necrosis proper of quittor, he always finds lesions in proportion to the intensity and the age of the disease. It is seldom, however, that the portions of the cartilage which have undergone the green degeneration, constituting the caries, reaches more than one centimeter in extent; they have the form of a small plate, of a green color, ordinarily elongated, and adherent to the healthy parts of the cartilage by one of its extremities, that which is more forward and the deepest. Others have compared it to the green growth of a seed in germination. The points of the fibro-cartilage which are in immediate contact with the carious portion, have also a slightly pale greenish hue. These are already diseased; there is already a beginning of necrosis; in the remainder of its extent the exfoliation is separated from the

cartilage by a reddish, soft tissue, which also lines the inside of the fistulous tract. This fistula, which extends from the necrosed spot to the skin, is but the hollow tract left by the diseased process upon the cartilage, while gradually destroying its substance. Always lined with a pseudo-mucous membrane, by a true pyrogenic apparatus, the fistula is often narrow, sinuous, irregular in its course and extent, especially if the disease is of some standing.

Renault, and after him Lafosse, have mentioned a special alteration of the fibro-cartilage which is sometimes met, and which Lafosse looks upon as a step toward recovery. It is a softening of the tissue, anatomically characterized by a loss of the consistency of the cartilage, resembling the case of the cellular tissue becoming indurated, or that of bones deprived of their earthly salts after soaking in weak acids; its yellowish color is then characteristic. It may be noticed during life, and is recognized by a softening in the region of the cartilage, which then yields, giving easily to the pressure of the finger; besides this, a probe introduced into the fistulous tract readily penetrates into the softened substance. But the true way to diagnosticate this change consists in raising the coronary band or after thinning the wall; then one will see and may feel the true nature of the transformation. Lafosse adds that, in presence of this alteration, the removal of the cartilage is no more necessary, for then the cicatrization is readily obtained by stimulating the sloughing of the necrosed tissue or by removing it.

With cartilaginous quittor there is always plastic infiltration of the cellular tissue surrounding the cartilage. Very often the wall of the synovial capsule of the articulation of the foot is somewhat thickened, and in that case there is less risk of injuring it during the operation.—(Rey.)

III. *Progress, Duration and Termination.*—Left to itself, the caries of the fibro-cartilage may last for a long time, through difficulty in determining its true nature. Spontaneous cure, however, is not impossible, as Renault proved it, and as many practitioners have seen it, especially in young and healthy subjects, when the disease is mild at its outset and effects parts of the organs where the fibrous element predominates, as in the posterior portion of the cartilage. This fortunate result follows the sloughing of the "bourbillon" which makes its appearance under the shape of a greenish particle.

But, ordinarily, the disease progresses slowly, destroying the cartilage by degrees, and the diseased process ceases only when the caries has reached the ligament of the joint, which it sometimes also attacks. The tissue of the fibro-cartilages has not the force of reaction possessed by other inflamed structures, and which is so well marked in cellular tissue. A process of suppuration, such as rapidly eliminates the mortified structure, cannot very readily take place in it, and when by natural forces the carious spot is eliminated and pushed outward, the surrounding tissues are most commonly already affected. These undergo the same alterations, and are eliminated in the same manner until the entire cartilage is destroyed. This process of caries by repetition may last a year.

In its progressive stage, the disease may spread to surrounding parts, such as the os pedis, the plantar aponeurosis, the ligament of the joint, or the sesamoid sheath, all of which may become the seat of inflammation. They are diagnosticated by the greater pain and more marked lameness, symptoms which are comparatively light in the simple necrosis of the cartilage.

Finally, as a possible complication of cartilaginous quittor, one may observe an entire emaciation of the animal, an alteration of the fluids due to a putrid or purulent infection; some authors claim to have even seen glanders and farcy follow it; this is inadmissible.

IV. *Diagnosis.* — Cartilaginous quittor is recognized only when there is a wound from which escapes the product of the suppuration and of the necrosis. This pus has nothing characteristic, notwithstanding what has been said. If it is thinner than that of a simple solution of continuity of the region, or that of simple quittor; if it is less fœtid than that of bony caries, it has, however, of itself some special characters, varying according to the subject and the degree of the disease, and especially resembling much that of sub-horny quittor. If the escape of the pus is slow, and it is desired to carefully examine it, a simple pad of oakum, kept by a few turns of bandages on the fistulous opening, will, when removed, give a sufficient opportunity to recognize its nature.

The probing will often assist in distinguishing the cartilaginous from the simple or sub-horny quittor. In these last, the fistula is less profound, and does not reach the thickness of the

cartilage; but, as in cartilaginous disease, the fistula is often sinuous, it is better to use a soft, flexible instrument, such as a fine probe made of lead. The injection of liquid may take the place of the probing; injected in a superficial tract, it returns outward directly, while in deeper and irregular fistulæ, it will penetrate more readily. The induration of the coronet, the rough and ramy appearance of the hoof of the quarter corresponding to the fistula, indicate generally a necrosis of the fibro-cartilage; these characters are missing in the furuncle.

V. *Prognosis.*—In consequence of the tenacity of the disease, this form of quittor is always serious; though this gravity has, in our days, greatly diminished, on account of the means of treatment now in use, which were unknown some thirty years ago. Now, this affection, which was considered by all hippiatrics as almost incurable and which more recently was treated by an operation which rendered the animal unfit for work for several months, can in the majority of cases be cured in about fifteen days.

The prognosis, however, varies and depends on the complication. When there is caries of the ligaments, inflammation of the articulation of the foot, or of the sesamoid sheath, the extirpation of the cartilage itself, done with the greatest dexterity, is not even a warranty of recovery. It remedies only the necrosis of the cartilage, but leaves the other diseased processes to progress in such a manner that the animal remains worthless if he has not to succumb to them. The pain is, besides the other signs, one of the most important points to consider: very acute, it is generally a discouraging omen, and points to the existence of serious complications.

VI. *Etiology.*—Heavy draught horses are more frequently affected, on account of their peculiar work. The most common cause is a bruise, a blow, a burn, a prick, any wound exposing the cartilage; it is most common in horses drawing trucks loaded with stones, which may drop on their feet and crush the fibro-cartilage. The same cause exists for horses working in extensive works of buildings, in the construction of railroads, and in the shops of mechanic construction.

Owing to these conditions, it is also more common in large cities than in the country, and more frequent in stony and temporary roads than in those which are smooth and flat. Flat feet, with low heels, are more exposed than others, as well as those

whose hoofs are soft. Quittor is more frequent in the fore than the hind feet, the fibro-cartilages of the fore feet being more developed and more flexible, and because their heels are generally lower than in the hind legs. In some, it is more common on the internal than the external quarters, while with us, it has been the contrary.

It is often a complication of suppurative corn; of punctured wounds of the foot, of canker, of simple and sub-horny quittor, of grease, etc., which are then the determining causes of the disease.

VII. *Treatment.*—When the disease is recent and the quittor acute, and antiphlogistic treatment may be attempted and resolution looked for, baths and emollients are generally beneficial. A good blister has sometimes proved advantageous, and when it is used, limited suppuration, with the formation of a simple slough, may take place.

If necrosis is well established, it is an indication of the necessity of a recourse to more energetic treatment, in which case several measures are recommended, including the actual and potential cautery and the removal of the cartilage.

In actual cauterization, the necrosed spot is destroyed by a cautery brought to a white heat, applied directly upon it, after it has been exposed by a free incision. It is a simple treatment, and one that has been successful in cases of posterior necrosis where much fibrous tissue was diseased, and principally in young and well-conditioned animals (Lafosse, Sr., Girard, Vatel, Mangin, Renault). Still, this treatment not only often fails, but may even become a means of irritation of the fibro-cartilage, and cause an extension of the necrosis. (Hurtral, D'Arboval, Lafosse). In our day, this treatment is almost entirely ignored by good practitioners, and the potential cautery more generally adopted.

This had already been employed by hippiatrics. Solleysel principally recommended the use of corrosive sublimate mixed with aloes; Girard, Barreyre and Bernard also mentioning it. English veterinarians recommended their use very strongly. (White, Blaine, Riding, etc.). These practitioners all used the solid caustic, either in the form of trochiscus or in powder, and if they obtained good results, it required a much longer time than that required in our day by the use of the liquid forms of caustics which are at our command. With the solid form, the action was of limited extent, and scarcely more effective than that obtained

by the actual cautery; moreover, they frequently injured the healthy structures by irritating them and increasing the inflammation, and thus resulting in serious complications.

As we have said, liquid caustics are largely used to arrest the spread of the caries; they modify the process of decomposition, dry up the suppuration and stimulate the tissues without injuring the healthy structures. This mode of treatment must be credited to Mariage, who in 1847 established the unfailing efficacy of repeated injections of Villate's solution; one of sulphate of copper and sulphate of zinc, 64 grammes of each in 1 liter of vinegar, and decomposed by 125 grammes of Goulard's extract. It is really simply a solution in vinegar of acetate of copper and zinc, holding sulphate of lead in suspension. Villate himself had already used his solution with success by injecting it in cartilaginous quittor as early as 1829, since which time Burgniet, Verrier, Sr., Collignon and others have recognized the benefit of liquid escharotics in the treatment of the same disease. Villate's solution is not a specific, and cartilaginous quittor has been cured by the injection of tincture of sublimate with solution of nitrate of silver (Bernard), with the perchloride of iron, chloride of copper, sulphate of copper and zinc, nitrate of lead, more or less concentrated mineral acids, and especially the Rabel water (Collignon).

It is difficult to say which is the more useful of these drugs and which has been more successful. Success has also been obtained with injections of tincture of iodine, phenic acid and even petroleum. It is less the nature of the drug that insures the effect than the mode of using it. We ought also to say that, advantageous as this mode of treatment is, it is not infallible, though Mariage and others so consider it. It is not to be preferred to the extirpation of the cartilage, an operation which proves successful when all other means have failed.

To obtain a cure by the use of liquid applications it is essential to make injections every day, and even several times daily. These are made with a syringe, carefully adapted in respect to size, with a small canula. The injection must be pushed well in, but must be allowed to escape freely after coming in contact with all the diseased surfaces which it is designed to modify. To effect this, it becomes necessary, as the fistulæ are sometimes very narrow, and even irregular, to enlarge them, or to make counter openings. Mariage had originally insisted that these precautions

were essential to the success of the treatment. H. Bouley and Viseur also strongly insisted upon the same point, viz., that of enlarging the fistula in order that the liquid should not be allowed to remain at the bottom of the fistulous tracts, by which all possibility of the extension of the disease from that cause might be avoided. These enlargements of the fistulæ, or counter openings, close, however, very rapidly; as a remedy to which, Hivernat has suggested the introduction into the tracts of little wedges of wood pointed like pencils, for the purpose of lacerating the walls of the fistula, followed by the insertion in them of small setons, moistened with Villate's solution. Guerrapain introduced a fine mèche of oakum, a seton in the tract, by means of a curved needle. If the fistula runs downward its bottom is under the wall, and he thins this down and makes a counter opening through the hoof thus thinned. This seton prevents the closing of the counter opening, and enables the operator to push through the injection regularly.

Other precautions are also necessary. One, especially, is rest. The animal must not be put to work. Lafosse says that these liquid caustics act with regularity and cure with certainty. A bar shoe, not pressing on the diseased quarter, is also useful. Emollient poultices are sometimes necessary after the injection, to diminish the irritation. Mariage also recommends them. If the fistula extends under the coronary band, or the podophyllous tissue, it becomes necessary to thin, or to remove altogether, the hoof of the diseased quarter.

After fifteen days of this treatment, the exfoliation often takes place, and recovery follows. Often, however, twice this length of time is necessary. After the first eight days the pus becomes more abundant, white and laudable; the tumor softens and diminishes, as the pain subsides. Later, the injections penetrate with greater difficulty, which is a good sign. The injections constantly attack the germ of the disease and leave it without chance to reform or to spread; the gangrenous structure which develops in the cartilage is changed into an inert substance; the pyogenic membrane of the fistulous tract is stimulated; the process of granulation becomes more rapid; the wound becomes more and more healthy, and the diseased process ceases. If, however, it continues, the wound changes its character, large granulations develop themselves, and in their center the openings of the fistu-

lous tracts, which open on the cartilage, make their appearance. At times the wound closes; but, after a short interval, opens again, or another forms at another point. There is then a repetition of the same course of treatment by caustic applications—but generally this indicates a complication, and suggests the propriety of an operation. The injections are generally successful, however, and most certainly so if the caries occupies the posterior parts of the cartilage. They may even succeed in the anterior parts, when the animal is young and of good constitution. But if the cartilage has already become partly ossified, the caustic is irregular in its action, and the result becomes doubtful. If the caries is deep and extensive, and especially if the necrosis extends through and through to a point corresponding to the synovial capsule of the articulation of the last phalanx; or if the necrosis exists on the internal face of the cartilage, where it covers that structure, then the repeated injections of Villate's, or of any other caustic, may be followed by serious complications. An old or complicated caries will offer an increased resistance to the treatment by liquid caustics, in proportion as there is more or less difficulty in bringing them in direct contact with the necrotic points.

The third method of treatment is that of the removal of the cartilage. This operation, first recommended by Lafosse, Sr., in 1754, was often performed by his son, and may be considered one of the most valuable results of the application of anatomical knowledge to the practice of veterinary surgery. This operation was also performed by Bourgelat and his students, by Girard, Hurtrel, D'Arboval, and was principally studied and described by Renault. In Germany, notwithstanding the writings of Langenbacher, Dieterichs and Hertwig, it did not meet with approval, and English veterinarians seldom, if ever, resorted to it. At present, even in France, it is seldom performed, except in case of failure by the caustic injection treatment, and this is often the case where the disease is situated in the anterior part of the fibro-cartilage, where the cartilaginous tissue predominates, or where the vitality is diminished, and above all, where ossification has taken place. It is an operation of the greatest delicacy, and accompanied with great risks on account of the proximity of the joint of the foot, and it requires an experienced operator and thorough practitioner to justify a hope of successful results. It consists in the excision, by layers, of the diseased cartilage, and

in avoiding injury to the coronary band, and to the podophyllous tissue, which are essential elements of the organization of the foot. It is also essential to avoid injury of the lateral ligament of the foot joint, which is close to the cartilage, and above all, of the synovial capsule of the joint, which is directly covered by the cartilage. The partial or entire extirpation of the cartilage can be performed. In the first case, only a portion of the necrosed fibro-cartilage is removed. Vatel, Sanstas, Renault, Bell and Lafosse have reported many cases of recovery by this mode of operation, but it is not likely to be thoroughly successful, unless in circumstances as favorable as those accompanying the treatment by liquid caustics. It is generally much better when the operation is decided upon to perform it by excising the entire structure, and removing all the carious elements. The partial removal is to-day entirely abandoned, and entire extirpation accepted as the true and only operative procedure. The best method of performing it is that recommended by Renault and adopted in our colleges. We shall make it the subject of description with all necessary details, and with various modifications as performed by other practitioners; we shall also offer some observations upon various other modes of performing the operation in question.

The operation includes two principal steps: first the removal of the part, or the whole of the wall corresponding to the diseased cartilage; and second, the extirpation of the cartilage itself. The opinions of surgeons vary as to the amount of hoof which should be removed, and the extent of horny tissue to be taken off. In respect to the length of the superior border of the portion requiring removal, it is generally agreed that it must extend from the anterior extremity of the cartilage backward, that is, the two posterior thirds of the space reaching from the toe to the heels, or one-third of the circumference at the coronary band. But opinion continues divided as to the lower border (Fig. 527). Lafosse, Sr., left it longer than the superior, and made the direction of the division of the groove correspond to that of the fibres of the hoof. Lafosse, Jr., accepting the idea of Solleysel and of Dieterichs, did not reach the sole with its groove, and removed only a portion of hoof parallel to the coronary band. Renault prefers crossing the fibres of the hoof with the groove, and brings the lower end of it to one-half the dimensions of the upper border, its groove running backward. Rey considers this to be running too far back and

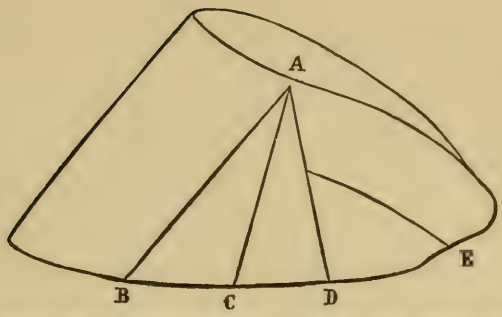


FIG. 527.—Direction the Groove should take to remove the Quarter in the Operation for Cartilaginous Quittor. *A B.*—According to Lafosse. *A C.*—According to Rey. *A D.*—According to Renault. *A E.*—According to Lafosse and Dietericths.

too near the heel, and recommends the groove to be so made that the lower border will have the same length as the upper, and for that reason advises that it be as nearly parallel as possible with the line of the heels. Lafosse, Sr., removes too large a portion of the hoof. Lafosse, Jr., leaves a portion of hoof which not only is useless, but which interferes with certain steps of the operation, when with the double sage knife, the skin is separated from the external surface of the cartilage, and also, when this is removed; and again, there is a separation between the severed portions of the quarters much greater than occurs in the process of Renault, which, like that of Rey, exposes the entire cartilage, and greatly facilitates the operation.

It is to be understood that the foot has been prepared; that the hair has been clipped over the skin covering the cartilage; that the sole has been pared thin, down to the blood, as well as the bar corresponding to the diseased cartilage, so that the quarter has been allowed to project below the sole, to facilitate its eversion. The foot has been, moreover, well prepared by two or three days of poulticing, to render the hoof easier to be cut by the instrument, and the operation easier to perform, and therefore shorter in its various steps, beside placing the patient in the best condition for the endurance of so serious an operation.

After casting the animal upon a good bed, and fixing the feet, placing a temporary hemostasis, by the use of a strong cord, similar to a tourniquet, around the coronet, a groove is made, using various-sized drawing-knives, running from the anterior angle of the lower border of the cartilage downward to the sole, following

the direction recommended by Lafosse, Sr., Rey, or Renault. This groove, made first with the widest, and finished with the narrowest of the drawing knives, must not touch the podophyllous tissue, and still must run through the entire thickness of the wall, without producing hemorrhage. In this step of the operation, as Girard correctly observes, short cuts of the knife are always better and quicker than those made by scraping or dragging with the instrument. It is also important to come down to the soft tissue at the coronary band first, and successively downward to the inferior border of the wall, as otherwise, as the instrument is moved from above downward, with a certain amount of force, it might slip and cause a serious division or laceration of the podophyllous tissue. The separation is then made of the wall from the sole by another groove, extending from the end of the groove already made, on the quarter, back to the heels. This is done without difficulty, with a small drawing-knife, when the foot has been properly prepared. There is, however, one point which usually offers more or less resistance when the quarter is removed. It is that where the wall is continued to the bars. This resistance is sometimes so considerable that if much traction is made, the wall will break more or less in front of the heels, where it is comparatively thin, and it may consequently become necessary to remove, by itself, the portion which has remained attached. This little accident, however, can be avoided by ascertaining certainly before the extraction of the wall is effected, that the continuity of the wall and bars has been cut off. This being the case, the complete separation of the wall from the sole is made by running the sharp edges of the double sage knife through the structure of the living tissue underneath. The resection of the quarter can then be proceeded with.

For this purpose, a properly constructed lever is carefully introduced into the groove before mentioned, at the wall and sole of the foot. The inferior and anterior angle of the hoof at this point being then carefully raised, an assistant grasps it with the nippers, turns it back and tears it slowly, while the surgeon, with such a motion of the lever as may be necessary, assists in the tearing off of the portion of the quarter requiring removal. If adhesions remain, interfering with this manipulation, they are removed by cutting with a sharp instrument. As this separation of the wall reaches about to the coronary band, the separation is very easy,

and no fear of lacerating the soft structures need be entertained. Care is necessary at this step, however, to avoid injuring the coronary band, and the podophyllous tissue; to prevent which it will be prudent on the part of the assistant to press upon the band as the separation takes place.

This being accomplished, the edges of the wound are carefully examined; any projections remaining are removed, and the blood is sponged off. The double sage knife is then carefully plunged, with the convexity turned upward (that is, toward the skin), between the external surface of the cartilage and the internal face of the skin, below the border of the coronary band, and then carried forward and backward, or as required, until the separation of the skin and the cartilage is completed and the external surface of the cartilage is exposed. In moving the instrument backward, it is necessary to be very cautious, especially while carrying the sharp edges downward and inward, in order to avoid injury to the coronary band and the skin, of which, however, there can be but little danger, when the knife is carefully held and properly directed. The succeeding step is to separate the skin from the cartilage; it is to be carefully raised and separated from its attachments underneath, which is sometimes a process quite difficult to accomplish, as the skin has always become more or less tumefied, and therefore has lost much of its natural flexibility and suppleness. Some operators, in order to avoid these difficulties, and overlooking the functions of the coronary band, cut it, and remove it, with those portions of the skin which cover the cartilage. Others, more conservative (Herting, for example) cut it only through the middle, until they reach the superior border of the cartilage, and then, raising the two flaps of the skin, accomplish the same result with less cutting.

The destruction of the principal organ of the secretions of the hoof having been involved in the first method, and having now taken place, it can never be restored to a healthy condition, and the animal continues to be exposed to the frequently serious complications of "false quarter." By the second method, the production of a new wall is nearly always accompanied with the formation of a "quarter crack." The recovery is slow in either case, and more or less deformity is likely to follow. It is, then, the better and wiser plan to separate the skin from below, and to avoid the division of the coronary bands or of the teguments.

The next step is the removal of the cartilage altogether. This is done with the single sage knife, held firmly in the hand, either the left or the right, always, however, that corresponding to the side of the heel to be operated upon. Taking a point of rest with the flat of the thumb upon the plantar surface of the foot, the instrument is pushed between the skin and the cartilage, and the sharp edge turned backward, with a firm rotary motion, downward and forward. The detached portion of cartilage is then seized with a pair of bull-dog forceps, and brought outward, and the sage knife is brought forward, downward and outward, from under the cartilage. It is a good plan, in order to make more room for working, to raise the skin and coronary band with a blunt tenaculum. The operation should always be commenced at the posterior part, in order to avoid the articular synovial capsule, which might be opened if the removal of the cartilage was begun forward. As the operator reaches the anterior part of the cartilage, which is situated almost over this capsule, it is prudent to hold the foot in excessive extension, and thus avoid injury to the capsule. This is an important point to consider in the operation. The sharp instrument being carefully handled, every portion of the cartilage is taken off, either at once, or better by layers successively, until the whole is removed. It is thus accomplished in three or four pieces. In some instances the anterior portion is cut off by a longitudinal incision, made with a straight bistoury, following the direction of the posterior face of the coronet, the object, in this case, being simply to render the operation easier. The cartilage is thus removed, great care being taken to avoid opening the capsular articular bursæ. It is essentially necessary to remove the whole of the diseased tissues, in order to bring the parts into the condition of a simple wound. Still, there need be no alarm if some small portions remain, more fibrous than cartilaginous, which, deep as they are, may protect the synovial capsules or the ligament; and moreover, they often slough off by themselves, with the abundant suppuration which follows.

To operate with the greater facility, it is well to have two forms of sage knife, one right and one left-handed, and some of extra strength, with which to remove the larger particles of cartilage, the others being small, thin and light, being adapted to the more careful dissection necessary toward the lateral ligament, and about the synovial bursæ of the joint.

Toward the end of the operation, the surgeon will, with the finger, carefully explore the condition of the parts, to insure himself that the cartilage is entirely removed; that the articular synovial sac has been preserved intact; that the ligament of the joint remains perfect, and that the parts are well washed, and ready for the dressings. Although in the absence of possible complications, the operation is now finished, it may yet be followed by some serious sequelæ, which we will next consider.

The operation may become complicated by a variety of attendant and accessory *circumstances*. Among these are, the opening of the articular capsules; the wounding of the anterior lateral ligament of the articulation; the ossification of the fibro-cartilage; caries of the os pedis; and the alteration of the coronary band and of the reticular tissue.

The *opening of the articular capsule*, either during the operation, or by ulcerative process, is not so serious an accident as it was originally thought to be. Still, however, it requires some attention. It only becomes dangerous when the ulceration is accompanied by serious disorganization, and especially when it is associated with purulent arthritis. (Renault, Hurtrel, D'Arboval, Bernard). It is treated by simple pressure, camphorated paste, a little corrosive sublimate mixed with starch, or better, with Egyptiacum ointment.

The wound of the ligaments has also been considered a very serious accident, which, according to Girard, cripples an animal permanently. But Lafosse thinks this an exaggerated notion, and claims to have witnessed the radical recovery of animals after the necrosis and sloughing of the ligament.

If *ossification of the cartilage* is discovered during the operation, the removal of all the unossified portion is first proceeded with, in order to prevent a recurrence of the disease. The extirpation of the osteo-cartilaginous portion is then effected, either with a small drawing-knife, or the gouge, or the bone forceps. The removal is made as far as the ossification is found to be complete, the operator making sure that every portion of cartilage is thoroughly destroyed. If the ossification is but partial or irregular, the surgeon must be guided by the condition of the parts. When the entire cartilage has undergone ossification, its susceptibility to caries has ceased.

When *caries of the os pedis* exists, the part must be destroyed

with the sage knife, the gouge, or the chisel, according to the existing conditions. But in this case, portions of the reticular structure require removal, of which, however, as little as possible should be destroyed.

It may happen that the *portion of the coronary band* covering the cartilage may be *destroyed*, either wholly or in part, either as an effect of the disease, or by accident during the operation. In the first case, if the entire band has been destroyed, there is nothing to be done. But in the other case, if any portions of it remain, care must be taken to insure their preservation, as they may supply the necessary elements for a new, healthy secretion of hoof, and the quarter may grow again, more solid and less deformed. If the wound of the coronary band consists merely in a simple division of limited extent, the wisest course will be to attempt to obtain union by immediate adhesion, or first intention, by bringing the edges of the incision together and maintaining the contact by careful dressing. When the *alteration of the reticular tissue* alone, is present, it is very essential to avoid the excision of the injured laminæ. It is, in fact, the better course to avoid wholly the use of sharp instruments, and to leave to the natural process of suppuration the removal of the disorganized parts. Renault having observed how their removal interfered with the reparative process, has often left them undisturbed, even when their dark color and softened condition indicated the smallness of their chance of conservation. The success of the operation after a first dressing, has shown the wisdom of the plan of non-interference; they were found covered with a new layer of yellowish hoof; and D'Arboval has on several occasions observed the same result.

The dressing must be methodically and carefully applied. Done well, a dressing greatly assists in the recovery, while many, when badly performed, have been the cause of serious complications, which have greatly hindered the repairing process, and often, indeed, rendered a disease incurable, which need not have been beyond remedy. In the application of the dressing, two points are important to consider: first, we must dress the subcutaneous wound, resulting from the separation of the skin and the extraction of the fibro-cartilage; the other, that of the sub-horny wound, produced by the removal of the portion of the quarter. Both are important, but the second requires the greater care, and

is more difficult and more important than the former; any excess in the sanguineous circulation must be prevented, and excessive granulations must be kept under control. The dressing, then, must be somewhat compressive, without being excessively rigid, in order to obviate possible danger of excessive inflammation; not too loose or so soft as to allow hemorrhage, or the undue proliferation of granulations. It must be both supple and firm, and of an even and uniform pressure. The proper material is balls of oakum for the subcutaneous wound, and pads of the same material for the sub-horny, the first being moistened with alcohol, while the others are made dry.

It is in question whether we should aim to obtain immediate adhesive union of the wound resulting from the removal of the cartilage, or in other words, whether it is good treatment to introduce some material of dressing between the skin and the bottom of the wound. Here opinions vary. Our belief is, that this union is by no means easy to secure; and that the removal of the cartilage, more or less altered, prevents it at various points. Still, we must not raise the skin too much, and choosing a middle course between, only a small, soft ball of oakum is now placed in the deepest part of the wound, or a thin pad is placed between the two parts, sufficient to represent about the natural form of the part, being enough, however, to prevent the immediate reunion from taking place.

A light, thin shoe having been prepared (Figure 528), adapted to assist the application of the dressing and its holding properly, it is put on with one of its branches cut off short on the side where the operation has been performed, while the other branch projects backward beyond the heel, to support the rollers of the bandage of the dressing. Desplas had thought to turn up that long branch of the shoe (Fig. 529) in the shape of a hook to assist in holding the dressings. This is

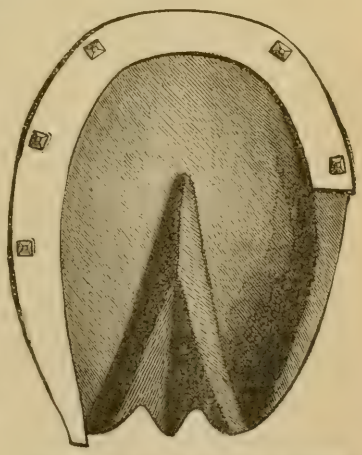


FIG. 528.—Truncated Shoe for Dressing in case of Cartilaginous Quiftor or Complicated Corn.

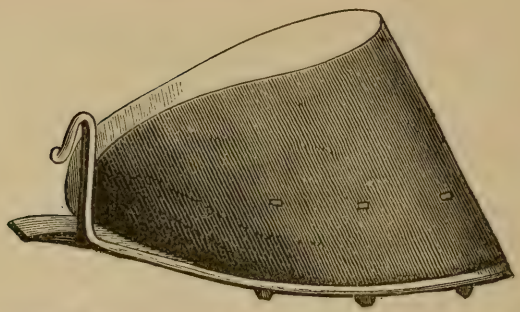


FIG. 529.—Desplas' Shoe for Dressing after Operation of Cartilaginous Quittor and Complicated Corns.

useless. Some veterinarians leave the animal unshod, but the bandage is more likely to slip off. The shoe must be put on while the animal is down, and before the application of the dressing. With some practitioners, that is the moment for the removal of the tourniquet or cord, which had been applied at the beginning of the operation in order to prevent the bleeding. This is an unnecessary precaution, and only renders the application of the dressing more difficult. First, balls of oakum are placed over the coronary band, then, upon the points of union of the preserved wall and of the podophyllous tissue, and then all over the wound. We must endeavor, as Renault says, to give the dressing a cylindrical form, or rather, according to Rey, hemispherical, after which the whole is covered with pads and rollers. These must be put on in abundance, the rollers passing over the branch of the shoe on the sound side, and running successively from above downward, and generally from before backward (Figs. 530, 531, 532, 533). Flat feet require special care in dressing, and the fore feet are generally more difficult to dress than the hinder. When all is finished, the animal has to be watched for several days. Ordinarily, after the operation, there is abundant hemorrhage, occurring within some fifteen minutes, and oozing through the dressings. This requires no special attention, and generally ceases spontaneously, or by the pressure of the dressing, or by the use of the cold bath. If the dressing seems to be too tight, and the animal shows signs of acute pain, with strong reactive fever, it is not therefore necessary to remove the dressing, but may be sufficient simply to loosen the bandage. The animal should be placed in a wide stall, or box, if possible, where he may move freely, and

VARIOUS STEPS IN THE APPLICATION OF THE DRESSING AFTER OPERATION FOR CARTILAGINOUS QUITTOR.

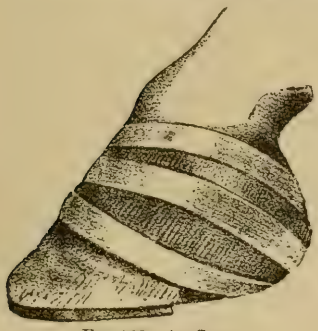


FIG. 530.—1st Step.

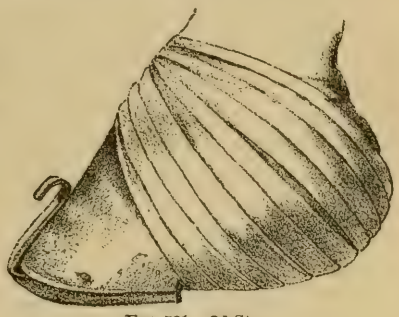


FIG. 531.—2d Step

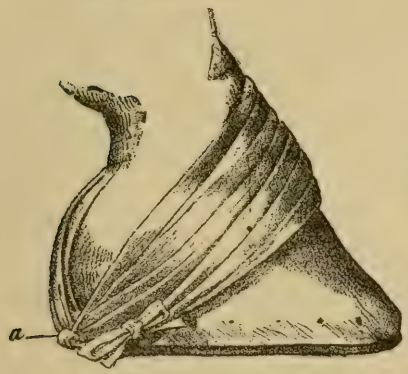


FIG. 532.—3d Step.

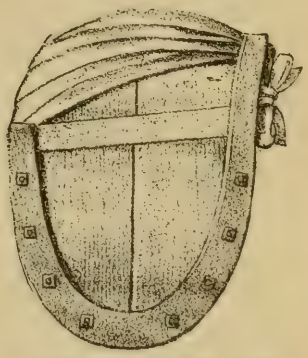


FIG. 533.—Dressing Completed.

lie down easily; and he must be prevented from tearing off the dressing by the application of a neck cradle. A low diet is necessary for several days, in some instances mashes being the only food allowed. Still, a good appetite and lively condition are always good signs.

The interval of time which should be allowed to elapse between the operation and the removal of the first dressing, should be judged by the amount of pain which the animal seems to suffer; by the temperature of the atmosphere; and by the amount of liquid discharge found oozing from the wound and moistening the dressing which covers and protects it. Generally, the dressings should be disturbed as late and as seldom as possible. Circumstances will sometimes occur, however, which necessitate their removal earlier, as for example, the extreme heat of the weather;

the extremely offensive odor proceeding from the diseased parts; and a sudden and evident increase of pain in the wound, without any known cause. Under these circumstances, which, however, are of rather infrequent occurrence, it is sometimes necessary to remove the dressing as early as the third day, although at this time, as suppuration is not yet well established, the operation is quite painful, and may be accompanied by free hemorrhage. But if the weather is not excessive; or the dressing remains dry on the outside, and matters seem to be generally in good condition, the better course is to wait from eight to ten days, before the dressing is renewed. Indeed, numerous cases are on record when a still longer period has been allowed to elapse, and the re-dressing has been deferred to the extent of three weeks, or longer. In any event, great caution must be exercised in the removal of the dressings, and the surgeon should be careful to have all his appliances ready in advance, in order that the wound may be exposed to the air for the shortest possible space of time. When exposed, the wound should be of a red color, with commencing granulations, and a temporary hoof, soft and whitish in appearance, should be visible on the podophyllous tissue. A dressing is then applied of tincture of aloes, or a weak solution of iodine. At a later period the dressings are changed at intervals of about eight days, and an application is made of pulverized sulphate of copper, in order to facilitate the drying and hardening of the soft hoof. Baths of sulphate of iron, with a small portion of sulphate of copper are of service in promoting and hastening the cicatrization.

About the thirtieth or fortieth day after the extirpation of the cartilage, the animal may be put to light work. But three or four months, if not a longer period, must elapse, before it will be safe to task him with heavy labor. Toward the end of the assigned term he should be fitted with a bar shoe, shortened on the side where the quittor has existed. If the dressing is skillfully applied and proper care is exercised, the diseased foot may be sufficiently protected, and the animal made to resume his work with safety.

In time, the portion of hoof secreted by the coronary band unites with that of the podophyllous tissue, and after a few months, no remains of the operation are visible. But if the coronary band has ulcerated; if the skin has been divided; if by contact of the firing iron, or application of caustics, it has been

destroyed; the quarter then presents irregularities, and sometimes divisions, which may be of long continuance, and give rise to a lameness which may, perhaps, become permanent. This danger indicates the necessity of exercising the utmost skill and caution in operating, in order to avoid possible injuries to the coronary band.

Several *modifications* of the ordinary mode of operation have been proposed. Some have had for their principal object, the prevention of the extraction of the hoof, with a view of thus returning the animals to their work at the earliest period practicable. It is thus that Hazard, Jr., proposed to make a crucial incision upon the skin covering the fibro-cartilage; the four flaps being so dissected as to expose it, and then removing it with the sage knife. In this process, the extirpation of the entire cartilage becomes extremely difficult without inflicting injury upon the lateral ligaments and the synovial capsules.

Pagnier has proposed to merely thin down the quarter, to make an incision in the skin along the superior border of the cartilage, and through this to remove the organ. But in this operation, however thin the hoof may be, it always interferes with the entire extirpation of the cartilage.

Bernard, following the idea of Lafosse junior, who only removed the superior border of the wall, proposed a mode of proceeding which is principally useful in cases of separation of the hoof. Instead of removing the band of hoof parallel with the coronary bourrelet, Bernard pared it down with the drawing-knife, the sage-knife, or the rasp, in order to make it as thin as possible, while avoiding the injury to the sensitive laminæ. This done, an incision is made along the coronary band, below it, destroying its union with the laminæ. At this step of the operation, the indications are the same as in the ordinary *modus operandi*, except that the coronary band being covered with a certain thickness of hoof, is less flexible. This, however, is easily removed, as soon as it becomes softened. The remaining steps of the operation are the same as in the ordinary, old way. That is to say, the posterior part of the cartilage being well defined, the sage-knife is used in the same manner. In this method, however, as the sage-knife works more flat-wise, there is less danger of wounding the ligaments or the synovial capsules. If any part of the cartilage remains near these organs, some care must be used in

removing it, and it must be done by degrees, and in very small portions.

The advantages of this process are: 1st, the avoidance of extensive wounds, and of the extreme pain produced by the extirpation of the quarter. 2d, to keep the foot shod, and to allow the animal to resume his work as soon as the first pain has subsided, which may occur at quite a considerable interval in advance of the perfect cicatrization of the wound. 3d, to avoid long and frequently-repeated dressings.

In this method, however, the quarter left intact sometimes interferes with the operation, and the excision of the cartilage is more difficult, being only practicable, indeed, in cases where there is a separation of the wall.

Maillet has modified the method of Bernard, so that, instead of thinning down the band of hoof, he only applies the rasp upon the quarter, and thins down with it all that portion which is extirpated in the process of Renault, and availing himself also, of the drawing and sage-knives. The remaining details of the operation are like those of the ordinary processes. An objection to this mode is that it can be put in practice only in cases where there is already a separation of the wall. It is objectionable from its tendency to weaken the foot too much, by interfering with the firm and solid adjustment of the shoe, as well as retarding its application to the hoof.

CHAPTER XIV.

OPERATIONS UPON THE EYE AND EAR.

ON THE EYE.

Ophthalmology, though it has made appreciable progress in veterinary practice within a few years, has not yet reached a position corresponding with that which it occupies in human surgery, and probably will not for years to come, if ever. The difference in value and importance between the functions of the organ of sight in the man and in the horse is too measureless to induce or require an equal amount of interest and study in the optical pathology of the two animals, the human and the equine. It is indeed, a fact that many of the forms of disease which affect the eye of the horse have not yet been recognized and investigated by students of veterinary medicine.

For these reasons the contents of the present chapter will be limited to those affections in which, strictly speaking, special surgical interference has been so imperatively needed as to compel the attention of scientific veterinarians, by considerations of both duty and interest.

We shall consider the subject under two principal divisions, or heads, viz., operations, performed on the *accessory*, and those pertaining to the *essential* organs of the ocular apparatus.

1.—Operations Performed on the Accessory Ocular Organs.

On the Eyelids.—These constitute the two cutaneo or mucous veils, which are situated in front of the organ, and are divided into superior and inferior, uniting at their extremities to form the angles or commissures of the eye. Besides these, there is a peculiar apparatus situated on the internal or nasal angle, known as a third eyelid, or *menbrana nictitans.* This is a small cartilage, thinned out on its free border, continued on its posterior portion with the adipose cushion of the eye, and covering it in front, wiping, as it were, its corneal surface, whenever the ocular globe

is drawn back into the orbital cavity. On the internal commissure are found the *caruncula lachrymalis*, showing on the upper and lower lids the *lachrymal puncta*, both of which empty into the *lachrymal sac*, which is itself continuous with the *lachrymal canal*, and through the *lachrymal duct* empties at the lower commissure of the nostril by the *lachrymal opening*.

Among the surgical diseases of the eyelids must be mentioned traumatic lesions, pathological growths, defective congenital conformations, and specific diseases of their elements.

A.—Traumatic Lesions.

Bruises of the eyelids are specially common in horses after kicks and blows in that region, and may also be the result of friction and chafing from the harness. If the cause has been severe, œdema of the lid is the result, as well as more or less flow of tears, and, possibly, irritation of the cornea. These accidents are generally of no great severity so long as the globe of the eye remains intact, but if this is injured serious complications ensue.

The indications of treatment are those of all similar injuries of a local character, consisting of cooling astringents, with local bleeding, which generally bring rapid relief.

B.—Solutions of Continuity.

These are very common with all our animals. They are seldom simple, but are more commonly complicated with lacerations of the tissues, by nails, hooks, etc., or even the teeth of other animals. Clean wounds by sharp instruments are rare, and are easier to treat than those having torn and irregular edges. They may be superficial, and may involve the thickness of the lid alone, but they may also be deep and complicated with wounds of the globe of the eye itself. The condition of the wound in this respect is important to know, and should be ascertained as early as possible. The raising of the eye with the elevator palpœbrum (Fig. 534) greatly facilitates this examination, and the animal seldom offers any serious resistance to it.

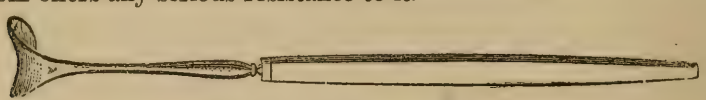


Fig. 534.—Eyelids Elevator.

Simple lacerations of the lids commonly heal without any treatment beyond mere cleanliness—a soft sponge and a little clean water. But the application of the pin or twisted suture, in connection with antiseptic measures will greatly promote cicatrization by the first intention. Care must be taken to confine the animal's head in such a manner as to prevent him from rubbing the wound until cicatrization is well established.

C.—Defective Congenital Conformations.

Under this head we shall consider the deviation of the lids, either outwardly or inwardly, from the convex lines of the cornea, with which they should be parallel. A deviation in the growth of the eyelashes, or ciliæ, is another annoying irregularity of the same region. The outward deviation of the eyelid is called *ectropion*; the inward, *entropion*. The deviation of the eyelash is known as *trichiasis*.

1. *Ectropion.*—The two principal causes of this abnormal condition are an excess of mucous membrane or deficiency of skin. Again, the ectropion depending upon paralysis of the orbicularis palpœbrum, is of a different nature. Ectropion occurs more frequently in the lower than in the upper lid When depending on a want of skin, it is generally the result of a wound or a burn, or possibly of an abscess, and is a *cicatricial ectropion*, in which the retraction of the cicatricial tissue has carried the lid with it.

Paralytic ectropion is the result of age, and is more or less peculiar to old animals. It may also result from a diseased condition of the conjunctiva, or of some of the organs of the orbital cavity.

The treatment of a case of this affection should be modified by the nature of its cause. If it is due to excess in the mucous membrane, the redundancy must be reduced. If caused by want of cutaneous surface, the remedy must be applied to that surface. If a hyphertrophied, mucous membrane is the trouble, astringents, caustics, and scarifications must be employed; or even the removal of portions of the conjunctival mucous membrane, with the scissors or the bistoury. If, on the contrary, the deformity results from the condition of the skin, *blepharoplasty* or *blepharortapy* must be resorted to. The simplest manner of operating consists in amputating a V-shape portion of the eyelid and uniting the edges with stitches.

2. *Entropion.*—This is a malformation in which the border of the lid is turned inward. While in an ectropion the skin is in excess, the reverse condition is discovered here, where it is deficient. It is often the result of ophthalmic attacks, and it may also follow a loss of substance in the conjunctiva, after ulceration, or the removal of foreign growths. According to Leblanc and D'Arboval it may follow some eruptive fevers, or parasitic diseases. In entropion there is an increased flow of tears, abundant muco-purulent secretion, keratitis, which may become ulcerative, and loss of sight.

The treatment consists in the excision of all the inverted portion of the deformed lid, which is accomplished by raising it from the globe with a forceps, and separating it with a single cut of the curved scissors, the protruding portion being then amputated. The hemorrhage is stopped with cooling lotions.

Another mode of operating consists in cutting off only a portion of the skin of the lid, and unfolding it by passing the finger under the inverted border. Then a fold of skin is amputated near the free border of the lid, and the edges brought together by twisted pin suture.

3d. The deformity of *trichiasis*, or abnormal growth of the lashes has been observed by Leblanc in sheep, but in our domestic animals is a rare disease.

Amputation of a portion of the skin; pulling out the eyelashes, followed by cauterization, and extirpation of the free border of the lids, have all been recommended against this abnormality of cutaneous secretion.

D.—Pathological Growth and Caries of the Membrana Nictitans.

Acute inflammation of the third eyelid, either as a symptom of ophthalmia, or resulting from direct traumatism, such as blows, or the presence of foreign bodies, terminating in caries of the constituent cartilage of this delicate organ, or the formation and development of epithelioma of the mucous membrane, are conditions often seen in our domestic animals, principally in horses and dogs. We have often noticed this peculiar affection, so easily recognized by the presence at the nasal angle of the eye, of granulating masses of various sizes, protruding at their internal commissure of the lids, and over the surface of the cornea, accompanied

with more or less suppuration, lacrymation and ectropion of the lower lid.

The epithelial growths, when small, will sometimes disappear under the application of caustics, or can be removed with the ligature, or by direct amputation with fine scissors. In some cases they assume very large dimensions, the mucous membrane becoming more or less ulcerated, and the cartilage itself diseased, and amputation of the entire cartilage becoming necessary.

This operation is not of recent origin, having been performed, within our knowledge, some years ago, though entirely upon empirical grounds, in tetanic cases, from the fact that the protrusion of the membrana nictitans over the inner side of the external surface of the ocular globe, quite out of its normal position, had often been noticed among the symptoms of lock-jaw. The *removal of the "hawck,"* as the operation was then called, has never, however, for the reasons which were them accepted, become legitimized among the therapeutics of the scientific veterinarian. The removal of part, or what is more effectual, of the whole of the membrana nictitans requires three instruments, a speculum oculi, a special forceps, like that of Snellen, and a pair of curved blunt scissors.

The animal must be thrown, and the eye being anestheticised with cocaine, and the lids kept well apart with the speculum, the organ, with the mucous membrane which covers it, is drawn out with the Snellen forceps, and by degrees severed in its continuity. When it is loosened sufficiently to be brought entirely out of the orbital cavity, it is separated with the scissors from all its attachments. The adipose mass which was then slightly protruding returns to its position and the operation is concluded.

There is always a little hemorrhage accompanying the dissection, which, however, is readily subdued by means of a simple compress of cold water. No special subsequent attention is necessary.

II.—Operations on the Lachrymal Apparatus.

A.—On the Caruncula Apparatus.

The caruncula lachrymalis is sometimes the seat of hypertrophy, as commonly seen in cattle, the vague designation of *Encanthis* being given to all such lesions of the caruncula lachrymalis, whatever may be their origin or nature.

It is an affection which is quite frequent in dogs, as the result of localized chronic conjunctivitis. It is characterized by a tumefaction of the organ, more or less developed, pedunculated, protruding in the inner commissure of the lids, and accompanied by lachrymation, caused by the obstruction of the lachrymal punctæ.

While at the outset anodynes and astringent collyria may sometimes control its development, there are many cases in which its removal by ligature or excision is indicated. Silk is recommended by Leblanc as the best material for a ligature, but elastic thread is in our judgement much to be preferred.

Excision is far preferable. The operation is a simple one, consisting in merely severing the peduncle with a curved scissors or

FIG. 535.—Bistoury for the Excision of the Encanthis.

a bistoury (Fig. 535), *ad hoc.* The comparative abundant hemorrhage that follows is controlled by cold water applications. The wound which remains is treated on general principles.

B.—On the Lachrymal Ducts.

The occlusion or obliteration of these little canals by foreign bodies, or as the result of inflammation of their mucous membrane, sometimes occurs in horses. Its characteristic symptom is an abundant and continual lachrymation, and it is only by careful examination of the condition of the orifices of the lachrymal punctæ, that a correct diagnosis can be assured; a thick, muco-purulent discharge sometimes oozing from them. Though this difficulty often subsides by resolution of the inflammation, or the use of washes and collyria, there are cases where surgical interference, of the nature of a true catheterism of the duct, with possibly an enlargement of its canal with the bistoury, cannot be dispensed with. The probe of Bowmann (Fig. 536), and the knife of Weber (Fig. 537), answer the purpose very well.

The animal is placed in the decubital position, the grooved probe introduced into the duct, and its wall divided with the knife, guided by the groove of the probe.

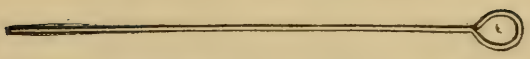


FIG. 536.—Probe of Bowmann.

FIG. 537.—Knife of Weber.

C.—On the Lachrymal Canal.

The obliteration of the lachrymal canal may become necessary in consequence of changes in the structure of its walls, or the pressure made upon it by the surrounding parts. In the first case, it occurs as the result of traumatic lesions, or of inflammation of the mucous membrane, the exudates accompanying it, and the accumulation of thick secretions in the channel of the canal. In the second case, it is due to severe rhinitis, swelling of the inflamed mucous membrane of the nasal cavities, polypi, bony growth of any kind, or in cases of dental caries.

The symptoms are: Lachrymation, filling up of the canal, its inflammation, and arrest of the flow of the tears through the lachrymal opening at the nose.

According to Professor Leclainche, there are four modes of treatment for the relief of this trouble.

1st. *Opening of the natural tract and removing the cause of the obstruction.*—This is done by the catheterism of the canal by means of fine probes, or by detersive injections forced through the inferior opening in the nostrils; or, again, as practiced by Director Trasbot, by insufflation.

2d. *Making an Artificial Tract.*—If the point of obliteration is situated near the lower opening of the canal, an artificial opening can be made above it. To do this, Leblanc recommends the introduction of a whalebone probe through the superior lachrymal opening into the canal until the place of obstruction is reached when a counter opening is made with a fine bistoury through the walls of the canal. Two or three silk threads are then introduced into the new passage between the two openings and left in place for about twenty days.

If the obliteration is in the bony portion of the canal, and cannot be overcome with the silver probe, the perforation of the lachrymal bone and an artificial fistula must be made.

Neither of these operations is often followed by successful results, although the perforation of the bone enables the tears still to escape in the nasal cavities. The formation of a fistula furnishes a channel for the flow of the tears over the lachrymal surface of the face.

3d. *Obliteration of the Natural Tract.*—The intention of this operation is to effect the entire obliteration of the duct from the lachrymal puncta and the lachrymal duct down. It is obtained by the cauterization of these parts, either alone or inclusive of the obliteration of the lachrymal sac. Tincture of iodine often produces the same effect. As the result of this treatment, the flow of the tears takes place over the face.

4th. *Extirpation of the Lachrymal Gland.*—This is not referred to as a practicable measure, but only because it is sometimes mentioned in the way of theorizing. The situation of the gland in our domestic animals renders the operation an impossibility.

III.—Operations on the Essential Organs of Sight.

On the Globe.—The essential organ of vision, or ocular globe, is a membranous ball, completely closed, and filled with transparent fluids of different densities, and popularly known as the *humors* (or *media*) of the eye.

This ball, nearly spherical, flattened from backwards in front, has its greater convexity in front, where it is closed by the cornea, a transparent expansion, thick and resisting; the *glass* of the eye. Posteriorly, it is composed of three capsular, concentrical sheaths, proceeding from without inward. These are the fibrous *sclerotic*, the *choroid* and the *retina* (Fig. 538).

In the cavity of the globe one of these membranes—the choroid—throws out, perpendicularly to the great axis of the organ, a septum, the *iris*, a kind of contractile diaphragm, perforated in its center by the *pupil*.

The *retina* is a membrane of special nature, being an expansion of the optic nerve, and performs the function of receiving the impressions of light, and transmitting its impressions and images to the brain.

The *humors* of the eye are three, considered from before backward, the most anterior being the *aqueous*, the most posterior the *vitreous*, with the *crystalline* lens in the intermediate position.

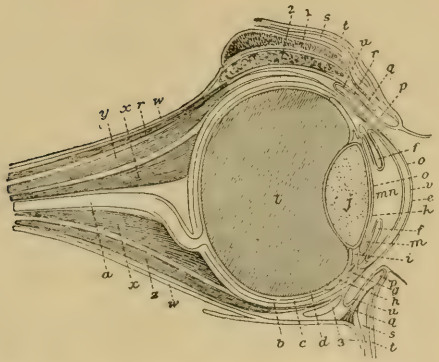


FIG. 538.—Theoretical Section of the Horse's Eye.

a.—Optic nerve. *b.*—Sclerotic. *c.*—Choroid.—*d.*—Retina. *e*—Cornea. *f.*—Iris.—*g h.*—Ciliary circle (or ligament) and processes given off by the choroid, though represented as isolated from it, in order to indicate their limits more clearly. *i.*—Insertion of the ciliary processes on the crystalline lens. *j.*—Crystalline lens. *k.*—Crystalline capsule. *l.*—Vitreous body. *m n.*—Anterior and posterior chambers. *o.*—Theoretical indication of the membrane of the aqueous humor. *p p.*—Tarsi. *q q*—Fibrous membrane of the eyelids. *r.*—Elevator muscle of the upper eyelid. *s s.*—Orbicularis muscle of the eyelids. *t.*—Skin of the eyelids. *u*—Conjunctiva. *v.*—Epidermic layer of this membrane covering the cornea. *x*—Posterior rectus muscle. *y.*—Superior rectus muscle. *z*—Inferior rectus muscle. *w*—Fibrous sheath of the orbit (or orbital membrane).

To this essential organ are added as accessories, first, a *muscular apparatus*, constituted by seven muscles—a *posterior straight* or *retractor*, four others, also straight, the *superior*, *inferior*, *external* and *internal;* and two *oblique*, or *rotators*, the *great* and *small*, or *external* and *internal oblique;* second, an *adipose pad;* third, an *apparatus of lubrication*, composed of the lachrymal gland and its means of conducting the *tears*, the product of its secretion, viz., the *hygrophthalmic canals*, the *puncta lachrymalis*, the *caruncula lachrymalis*, the *lachrymal ducts*, the *lachrymal sac*, and the *lachrymal canal.*

The whole mass of this apparatus is enclosed in a conical fibrous sac, the *ocular sheath*, which forms a membranous lining, as it were, to the *orbital cavity*, or bony box, which is anteriorly open, except when closed by the *eyelids.*

Our design in the present chapter is to confine our consideration entirely to such portions of surgical *ophthalmology* as are likely to demand the careful and practical attention of the veterinarian.

A.—The Extraction of Foreign Bodies on the Surface of the Globe.

The presence of a foreign body between the lids and the globe of the eye is just as painful to animals as to man, and may, if allowed to remain, give rise to symptoms of irritation and inflammation which, unless promptly relieved, may induce severe attacks of diseases which may compromise the usefulness of the organ.

Dust, insects, and small seeds of various kinds may indeed find a lodgment in the eye, and resist the efforts made for their removal, notwithstanding the excited function of the membrana nictitans, or the super-excited flood of tears stimulated by their presence.

Immediate removal is the first indication. This may sometimes be effected by bringing the lids together and keeping them temporarily closed until the stimulated collection of tears washes out the offending substance.

If this fails, cocaine must be applied upon the eye, and when its full effect is obtained, careful examination must be made, if necessary, with the assistance of a loup, by everting the lids, in order to bring the entire surface of the cornea into view The irritating body may be wiped out with the finger, a piece of cloth, or a soft camel hair brush, or when the object is hard and angular, as a particle of metal or stone, which has become partly imbedded in the cornea, the forceps may be necessary.

B.—Puncture, or Paracentesis of the Cornea.

The object of this operation is to empty the anterior chamber of the eye of its aqueous humor, of a collection of pus, or to effect a release of a living intruder from the cavity of the eye, as, for example, the parasitic *filaria oculi*.

The operation is simple, but the use of cocaine cannot be omitted. The instruments necessary are a cataract knife, or a lanceolated bistoury (Fig. 539). It is introduced obliquely through the cornea, at a very short distance from the sclerotic, and its in-

Fig. 539.—Lanceolated Bistoury.

troduction of course causes the immediate evacuation of the fluid contained in the anterior chamber, and the dropping or collapsing of the cornea, which assumes a rough and shrunken appearance. In a few hours, however, it resumes its normal condition, the secretion of the humor having taken place, and the wound of the cornea being closed.

Compresses of cold water, and the application of a weak solution of atropine will obviate severe symptoms.

C.—Staphyloma.

This designation applies to a deformity or distension of the cornea, consisting in its protrusion beyond its normal and symmetrical convexity. It varies in shape, and may be round or pointed. It is very common in dogs, especially in young ones, and if not discovered and attended to in its first stage becomes very rebellious to treatment. If overlooked and neglected ulceration of the cornea and destruction of the eye is certain.

Cauterization, with nitrate of silver, the ligature, and complete excision with the scissors are recommended, but the chances of success depend on the length of time it has existed and the size it has attained.

D.—Cataract.

The opacity of the crystalline lens, or that of its capsule, or that of the humor of Morgagni, or of these three conjointly, produces loss of sight, and for its re-establishment the operation called "of the cataract" is, in some exceptional cases, attempted on horses and dogs.

The object in view is the extraction of the opaque lens; its division into fragments that may be resorbed; or its dislocation from its normal position. It is not often performed in veterinary practice, but successful attempts have been credited to Vatel, Lafosse and others, while still others, as Gohier, Brogniez, H. Leblanc, Haubner, Hertwig and Hering have reported their results as sometimes successful and sometimes otherwise.

The animal is to be placed in the decubital position, and the dilatation of the pupil is to be obtained by the application of a solution of sulphate of atropia or extract of belladonna.

Among the difficulties connected with this operation is the peculiar anatomy of the globe of the eye, which by the action of

the posterior rectus muscle is drawn back in the orbital cavity, a displacement which not only renders the action of the instruments more difficult, but also stimulates the motion forward, over the cornea, of the membrana nictitans. The immobility of the eye is one of the first points to be secured. There are two ways of securing it, one fixing it from the front, the other from behind.

It can also be fixed from the front in two ways—that of Leblanc and that of Brogniez. Leblanc uses a tricuspid stylet (Fig. 540), which has three branches, two of which are applied on the

Fig. 540.—Tricuspid Stylet of Leblanc.

sclerotic at the internal angle of the eye, the third, which is movable, resting also on the same membrane at its inferior part. The first two keeps the membrana nictitans from the cornea, and all three, implanted into the sclerotic, keep the globe immovable.

Brogniez uses a special instrument, which he calls a "diaptator" (Fig. 541), which is a metallic rod, having three or four

Fig. 341.—Brogniez Diaptator.

points, twisted like those of a cork-screw, which by a slight pressure, combined with a little twist of the instrument, completely fixes the ocular globe.

To fix the globe from behind, Hayne, Dieterichs, Prinz and Bleiweiss make an incision through the skin behind the orbital arch, and an assistant, with one of his fingers passed through it, keeps it in place by direct pressure.

General anesthesia is always indicated. Peuch and Toussaint recommend the use of the Waldon forceps (Fig. 542) to immobil-

Fig. 542.—Forceps of Waldon.

ize the eye. It operates by grasping the conjunctiva on the inner angle of the organ, and keeping it motionless by a slight pressure. The lids are kept widely separated by means of the speculum oculi already mentioned. There are three principal modes of operation besides these, which are used in human surgery, which result in the union of these principal methods.

1st. *Method. Dislocation of the Lens.*—It is intended to displace the cataract *en masse* from the pupilar focus, and to fix it in a dependent part of the chamber, behind the iris, where it will no longer intercept the light.

It is generally performed in two ways—through a puncture of the sclerotic (Scleroticonyxis), or by puncture through the cornea (Keratonyxis). The instrument used is called Scarpa's needle (Fig. 543). This is either straight or curved. The eye being fixed,

FIG. 543.—Scarpa's Needles.

and the pupil dilated, the needle is introduced through the sclerotic, on the outside, and lower part of the globe, a short distance back of the cornea (Fig. 544), pushing it in a direction first slightly obliquely upward, and then horizontally. The needle has thus

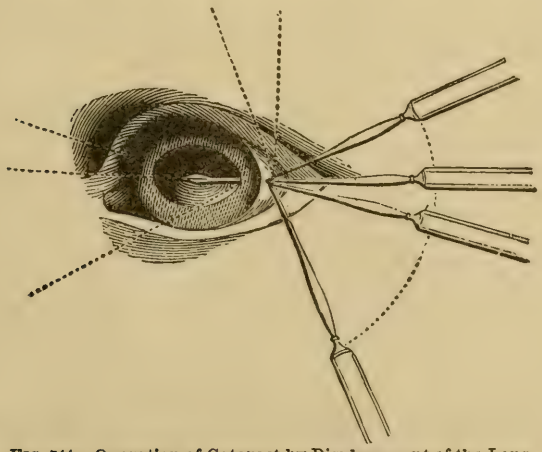


FIG. 544.—Operation of Cataract by Displacement of the Lens.

penetrated between the ciliary processes and the border of the lens, and presently becomes visible to the operator, passing beyond the internal border of the pupil. By a slight motion upward and downward, the capsule is then opened and the lens depressed, first backward, then vertically, and pushed downward into the lower part of the vitreous humor. A gentle rotation of the instrument then releases it from the substance of the lens, and it is returned to its horizontal position. The instrument is not withdrawn until it is ascertained that the lens is established in its new position.

When the puncture is made through the cornea the entrance into the eye takes place near the center of this membrane, and the access to the lens takes place through the opening of the pupil.

In either case the wound of the globe is insignificant.

2d. *Method. Extraction.*—There are two principal modes of operation, one by extraction through a flap of the cornea upward, and another by a linear incision on the side of the globe.

In the operation by the *flap upward*, the knife of Richter, modified by Beer (Fig. 545), is introduced horizontally through

FIG. 545.—Knife of Beers.

the cornea, near the sclerotic border, a little above the horizontal diameter of the globe, with the edge turned upward, and as soon as the point of the instrument has entered the anterior chamber of the eye, it is pushed in a straight, horizontal direction, passing into the anterior chamber (Fig. 546), and when its point reaches the opposite side of the cornea, it is pushed through it in such a manner that its exit and its entrance occur at equal distances from the sclerotic border.

The flap is completed by pushing the instrument directly out, when the aqueous humor escapes, and the cornea collapses.

The anterior wall of the crystalline cover is then divided with the kystitome (Fig. 547). The hook of which turns backward, and is made to tear the envelope by moving it from above downward and from within outward. The upper lid being raised with forceps, and a gentle pressure made with the finger at the lower

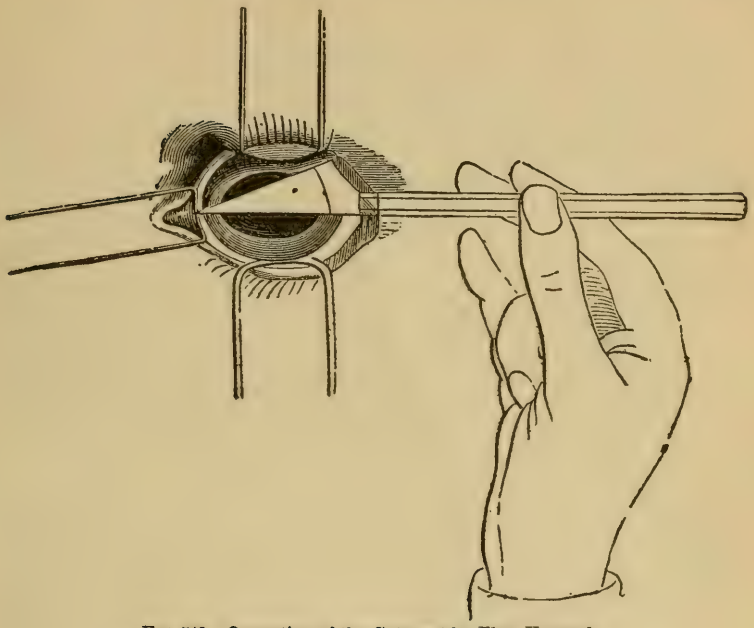


FIG. 546.—Operation of the Cataract by Flap Upward.

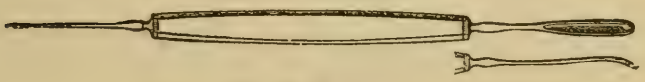


FIG. 547.—Kystitome.

border of the cornea, the lens presently falls out through the incision. If it becomes engaged in the wound it can be removed with the forceps or the curette of the kystitome.

Unless care is taken at this point to avoid making too great a pressure upon the eye, there is danger of the escape of the vitreous humor. The lids are then brought together and a light bandage applied, and as in other cases, the animal must be prevented from disturbing the wound by rubbing or otherwise.

The *linear method* consists in making a straight incision on the outside border of the cornea with the knife of Graafe (Fig. 548). It is principally employed in cases of soft cataract.

FIG. 548.—Knife of Graafe.

E.—Amputation or Extirpation of the Eye.

This operation is only indicated in cases of degeneration of the globe, and after special traumatic lesions of the organ. It is comparatively a simple one, and not as dangerous nor as painful as it is generally supposed to be. It can easily be performed with a simple or a blunt bistoury. Hertwig recommends a sage-knife, and we have often performed it with only a pair of curved scissors.

With the lids well separated, the eye, or what may remain of it, is secured with a pointed tenaculum, or a pair of forceps, and the conjunctiva divided in all its circumference with the knife. Then passing the bistoury into the orbital cavity, close to its walls, and cutting from the inside, and thence to the inferior part, the entire mass is detached, with the exception only of being held by the cord of the optic nerve.

This last attachment is then severed with the scissors. The hemorrhage which always accompanies the operation is readily subdued by pressure. Simple cleanliness is all that is required in the subsequent treatment.

Doctor E. Rolland describes his *modus operandi* for the enucleation of the eye as follows: The operation requires a speculum oculi, a hook such as is used in the operation for strabismus, curved blunt scissors, forceps to fix the eye, and a pair of scissors curved on their flat for the section of the optic nerve.

The lids being held apart with the speculum the operator grasps a fold of the conjunctiva, on the outside of the eye, and slits it near the border of the cornea. Then, with the scissors, the conjunctiva is entirely divided round its margin, near the corneal border. The sub-conjunctival cellular tissue being afterward divided with the scissors, the muscles are brought out with the strabismus hook and divided, beginning with the external rectus. The speculum is then removed, and by pressing firmly on both lids, the globe of the eye is pushed out of the orbital cavity. The curved scissors are passed behind the globe, and the optic nerve amputated at its point of entrance into the globe.

The operation ended, the orbital cavity is washed out with cold sterilized water, and is then filled with pulverized and sifted boracic acid. This dressing is removed daily for five or six days, and the eye protected as in Fig. 549.

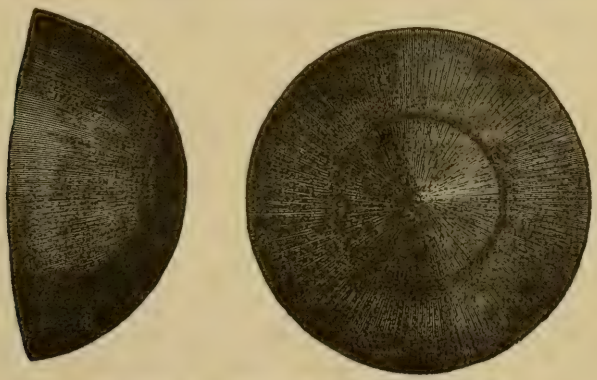
FIG. 549.—How to Protect the Eye.

OCULAR PROTHESIS.

The animal which has undergone the preceding operation is considerably deformed, but the difficulty is easily remedied by the insertion of an artificial eye.

Artificial eyes for horses were first introduced by Schmidt in 1850. They were originally made of glass, but many varieties of material have since been used, and to-day all instrument-makers probably keep them in stock, of hard rubber and gutta-percha, etc. By the skillful use of pigments the artificial organ can now be made to so closely match its living companion as to be undistinguishable from that which the animal has always carried (Figs. 550 and 551).

But the artificial organ must not be introduced into the orbital



FIGS. 550, 551.—Artificial Eye—side and full view.

cavity until all granulations, suppuration and inflammatory processes in and about the wound have ceased.

To put the artificial eye in place the upper lid is raised and the the border of the artificial organ placed underneath it; in the meanwhile the lower lid is drawn downward and the corresponding border of the eye pushed on its internal face. The eye is in place, especially if after its introduction the animal makes a few motions with his lids, all the folds of which are soon removed. To remove the eye the lower lid is drawn downward, and it is dislodged by passing a blunt probe under it toward its posterior face.

The artificial eye will not need removal oftener than once in eight or ten days. If worn too long there might be danger, with certain materials, of softening. The advantage of having an alternate eye will, upon reflection, become obvious.

ON THE EAR.

Amputation.

Usually, only horses and dogs are subjected to this operation.

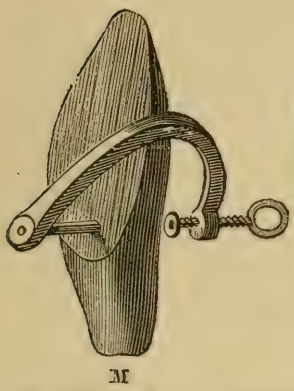
With the horse, the object is commonly either the correction of a deformity, or the cure of disease or injury.

When performed upon the dog, it is principally as an operation of fashion—so-called—or in compliance with some prevalent caprice relating to a supposed improvement in the appearance of the animal. Yet with these it must at times, of course, become necessary for the repair of an accident. It should be understood that the seat of the operation is in all cases the cartilage of the concha.

Amputation in Horses.—The amputation may be either *partial* or *complete.* One ear may exceed the other in size, and it may become necessary to trim down the larger for the sake of establishing symmetry between the mismatched pair with the knife. Or both may be similarly misshapen, and a partial amputation of both may be, therefore, indicated, for the same æsthetic reason as that which influenced in the other case.

This operation is seldom, if ever, performed at the present time. The complete amputation is indicated in cases where the cartilage is affected with pathological degenerations, and especially when these exist toward its base.

Partial amputation may be performed with the patient in any posture, and may be considerably simplified by using Brog-



FIGS. 552, 553.—Brogniez Apparatus for Amputation of the Ear.

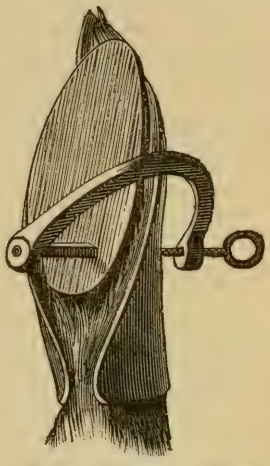


FIG. 554.—Apparatus of Brogniez in Position.

niez's apparatus. This consists of a wooden model of the inside of the cartilage (Fig. 552), and of metallic envelopes or patterns of the outside (Fig. 553) of which there should be separate ones for each ear. Both the wooden model and the metallic pattern are held in place by a systematic screw (or wood screw) like those usen by cabinet-makers in gluing wooden joints together. The apparatus is adjusted as shown in Fig. 554, and the excision of the protruding cartilage is made with the bistoury.

Amputation with the nippers of Garsault (Fig. 555), or that with the bistoury do not give equally satisfactory results.

Complete amputation, according to Peuch and Toussaint, is best performed with the animal under complete anesthesia. We have had opportunities of operating without it, but it cannot be questioned that it furnishes powerful assistance, when it becomes necessary to keep the head in place, as in this case.

FIG. 555.—Nippers of Garsault.

We consider the operation to be comparatively a simple one, though delicate handling is required.

A convex bistoury or scalpel, dissecting and artery forceps and needles and thread are the instruments required.

A circular incision is made always, if possible, by one stroke of the knife, toward the base of the cartilage, beginning at about the lower commissure of the external opening of the concha; then carefully avoiding the division of the bifurcation of the parotid gland, the insertion of the muscles attached upon the concha is divided, the posterior and anterior auricular arteries are ligated, the adhesions with the surrounding cellular tissue are lacerated with the handle of the scalpel, and the ligament which unites the concha to the annular cartilage is severed, the little prolongation of the former can then be easily followed to its end, and the concha be readily extirpated by lacerating its cellular attachments.

The wound is closed with sutures, and treated in the usual way.

Amputation in Dogs.—Although, as we have remarked, this is principally an operation of fashion, there are still conditions in which it is rationally indicated. It is commonly performed with scissors, curved or straight, with which the required portions of the concha are amputated by a single cut of the instrument.

Instruments have been invented to insure a more certain success in the operation, and a neater finish after the wounds have

FIG. 556.—Nippers to Amputate Dogs' Ears.

healed. The limitation forceps, represented in Figure 556, possess some advantages in these respects.

In any mode of operation, the flap of skin first excised becomes the only true pattern by which to shape the second.

The operation is generally followed by some hemorrhage, but this either subsides spontaneously, or by the application of local hemostatics, and the cicatrization proceeds without help under the scab, which after a day or two covers the edges of the wound.

CHAPTER XV.

DISEASES OF THE WITHERS.

The withers is the region of the body which, of all others, is most exposed to lesion, the injuries to which it is subject being of every form, nature and degree of severity. From its very location it is especially liable to all kinds of external traumatisms, and is peculiarly apt to suffer from blows, bruises, bites, contusions, pressures and frictions by the harness, etc., and these give origin to bloody or serous tumors; cold and warm œdemas, abscesses superficial or deep, and various wounds of the surface, with or without injuries of the subjacent tissues; and these again may be followed by necrosis of the dorso-cervical ligament, and of the apex of the dorsal vertebræ, accompanied with purulent filtrations, in various localities, the formation of fistulous tracts, and possibly the extenston of the diseased conditions to the ligamentum nuchæ, ending with the disease of the neck, with all its unfortunate sequelæ.

With the consideration of such a multiplicity of pathological evils before us, an orderly and systematic arrangement of topics is especially necessary, and we shall, therefore, in our treatment of the diseases of the withers, adopt the classification of Bouley and Nocard. And this introduces us successively to the study of *excoriations*, *œdemas*, *hematoma*, *core or stickfasts*, *cysts*, *abscesses*, *wounds*, and the "*diseased withers*" proper, or what is generally understood as "the persisting lesion, fistulous in its character, and whose condition of formation and duration is due to the mortification of the fibrous, yellow or cartilaginous tissue of the apex of the spinous processes of the anterior dorsal vertebræ."

Considered from an anatomical point of view, the withers form a very complex region. Its skeleton is formed by the superior spinous processes of the anterior dorsal vertebræ, and it is surrounded by muscles arranged in layers, intersected by fibrous

aponeurotic bands or sheaths. The vertebræ give attachment by the cartilaginous nucleus, which is at their apex, to the posterior portion of the yellow, elastic cord, which is part of the funicular portion of the ligamentum nuchæ, and are also united by the interspinal ligament. The muscles which rest upon the vertebræ form six different planes, thus divided: 1st. The *skin*, lined inside by cellular tissue, more condensed toward the median line than on the sides, where it is loose; 2d. The *trapezium* muscle, thin and aponeurotic inferiorly, but thicker in its upper portion,

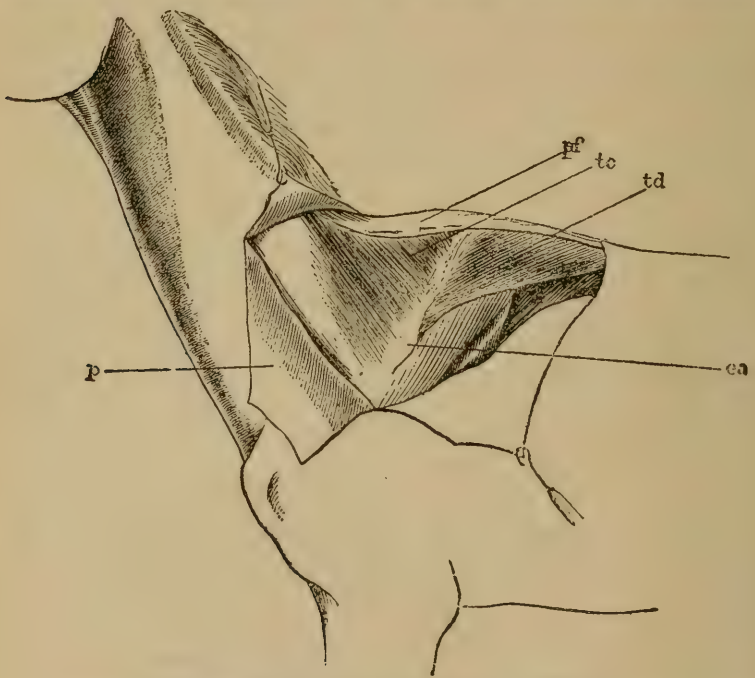


FIG. 557.—1st and 2d Layers of the Region of the Withers.

P.—Skin folded down. pf.—Funicular portion of the cervical ligament. tc.—Cervical portion of the trapezium. td.—Dorsal portion of the same. ea.—Acromion spine

which is muscular (Fig. 557), and lying over the external surface of the scapula and its cartilage of prolongation. 3d. The *rhomboideus* muscle, which is separated from the second plane on its external surface by a layer of loose cellular tissue (Fig. 558), and is lined in its internal face, by a yellow elastic band, inserted on the inside face of the cartilage of prolongation of the scapula.

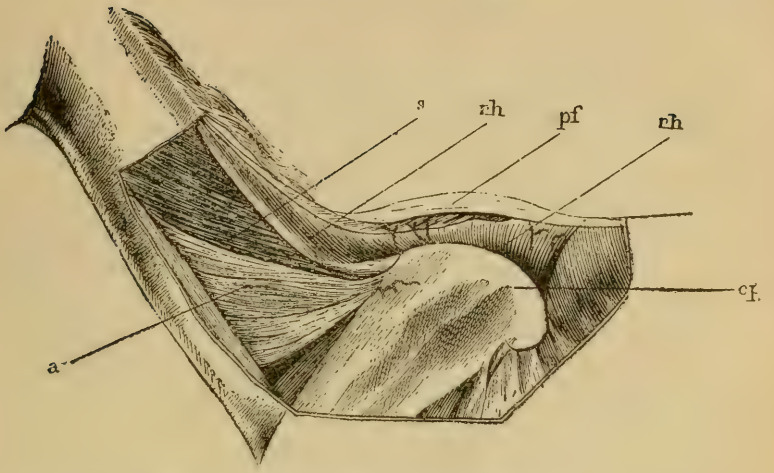


FIG. 558.—3d Layer of the Region of the Withers.

cb.—Cartilage of the scapula. pf.—Funicular portion of the cervical ligament. rh.—Rhomboideus muscle. a.—Angularis of the scapulæ. S.—Splenius.

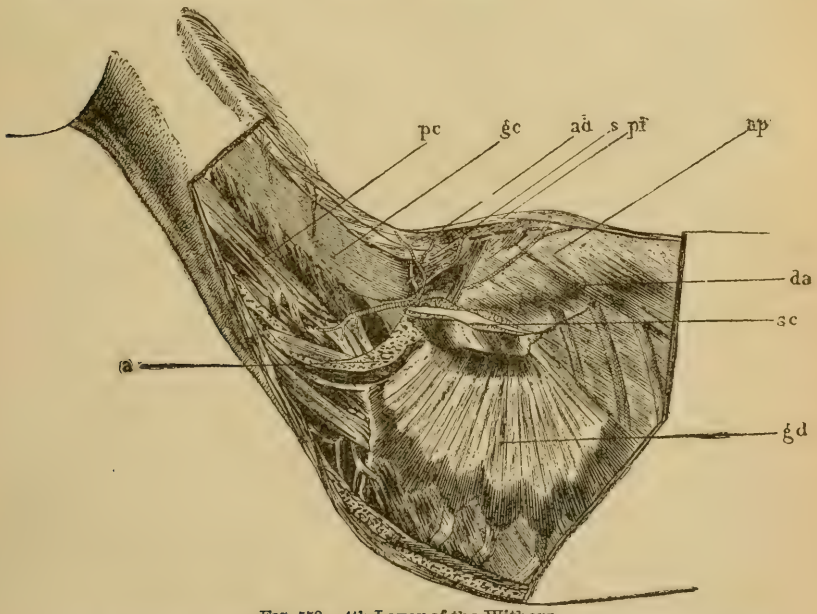


FIG. 559.—4th Layer of the Withers.

sc.—Section of the scapula and surrounding muscles. da.—Anterior small serratus. ap.—Its aponeurosis. gd.—Great serratus. pf.—Funicular portion of the cervical ligament. s.—Inferior attachment of the splenius. ad.—Ramifications of the dorsal artery. gc.—Great complexus. pc.—Small complexus. a.—Section of the angularis scapulæ.

This band is specially liable to attacks of necrosis. 4th. The superior portion of the *anterior small serratus* muscle, which is formed by a broad aponeurosis, attached to the superior extremity of the spinous processes of the vertebræ (Fig. 559). 5th. The

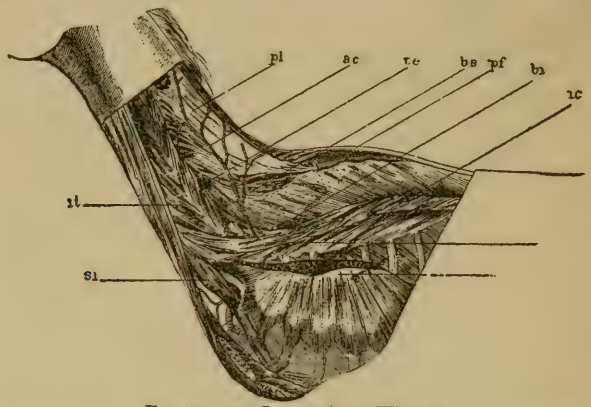


FIG. 560.—5th Layer of the Withers.

pl.—Lamellar portion of the cervical ligament. pf.—Funicular portion of the same. ac.—Superior cervical artery. te.—Transversal spinous of the neck. bs.—Superior branch of the spinalis. bl.—Inferior branch of the same muscle. ic.—Common intercostal. ad.—Dorsal artery. gd.—Great serratus. si.—Inferior scalenus. it.—Intertransversalis muscle.

anterior portion of the *ilio-spinalis* muscle (Fig. 560). The 6th and the deepest of these planes, resting on the faces of the long spinous processes of the vertebræ, is formed by the *transverse spinal* muscle of the back. (Fig. 561). To these are to be added the posterior extremities of some of the muscles of the neck, covered by the internal face of the scapula, the ramification of the large blood vessels, branches of the anterior aorta, and the dorsal and superior cervical artery with the spinal nerves which are distributed in that portion of the body. If we map all this distinctly in our minds, we shall have the material for forming an idea of the structure of the withers, and the intricate and interesting arrangement and disposition of its many parts, with their relation to the ailments which attack them. This will be facilitated by an inspection of the illustration (Fig. 562), representing a transverse section of the entire region involved. The drawing exhibits the obliquity of the direction of the various muscular layers, and demonstrates the tendency of the purulent gatherings, by gravitating and collecting between them, to contribute to the

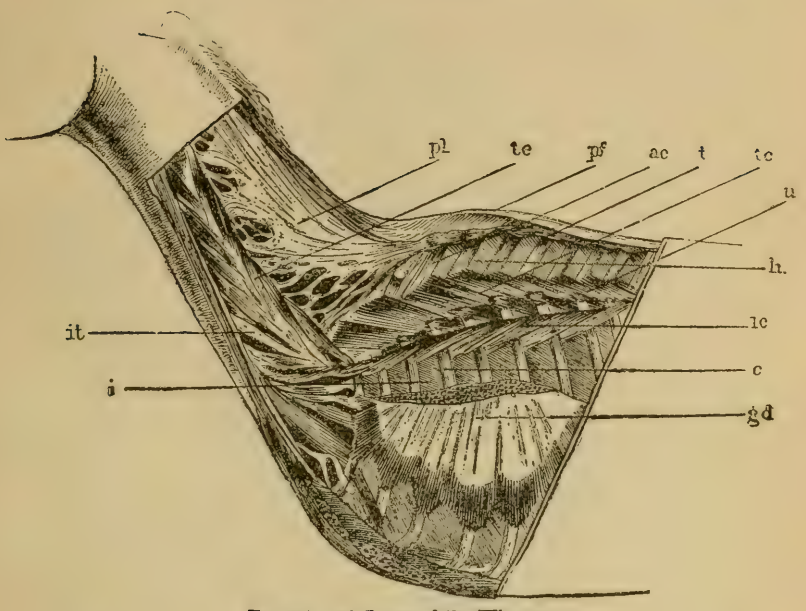


FIG. 561.—6th Layer of the Withers.

pl.—Lamellar portion of the cervical ligament. pf.—Funicular portion. te.—Transverse spinalis of the neck. ac.—Spinous processes of the dorsal vertebræ. t.—Tuberosities of the same. te.—Transverse spinalis of the back. ie.—Common intercostal. c.—Ribs. gd.—Great serratus. it.—Inter-transversalis. i.—External intercostal muscle. l.—Inter-spinalis ligament.

formation of the ailment recognized as a true "diseased withers," with the habitual severity which is its characteristic.

The originating causes of the diseases of the withers may be divided into the *predisposing* and the *occasional.* Among the first are to be noted a defective anatomical conformation of the region; the kind of work performed by the animal, and the degree of care he receives. For example, when the withers are low, thick and fleshy, as in heavy draught horses, the saddle of the harness has a tendency to slip forward and cause chafing and excoriation, an accident from which, however, animals with high, sharp withers are by no means exempt; for though, for the reason stated, they are less liable than those of the other conformation, the advantage is offset by the fact that the skin is exposed to a more unequal pressure, especially if that part of the harness is not properly padded and fitted, and presses irregularly on the soft tissues, upon which it rests.

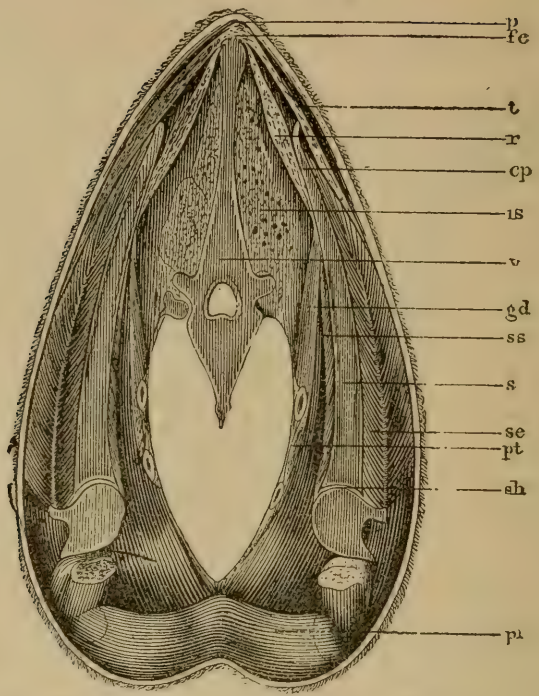


FIG. 562.—Transverse Section of the Region of the Withers.

p.—Skin. fe.—Fibre elastic tissue. t.—Dorsal trapezium. r.—Rhomboid muscle. cp.—Cartilage of the scapula. is.—Ilio spinalis. v.—5th dorsal vertebra. gd.—Great serratus. ss.—Sub-scapularis. s.—Scapula. se.—Antea-spinatus. sh.—Scapulo-humeral joint. pf.—Deep pectoral. pt.—Thoraciq walls.

Saddle horses are for the same reason peculiarly apt to become sufferers from the lesion of which we are speaking. The self-inflicted bites and the scratching and rubbing of animals suffering from parasitic affections, in their efforts to relieve themselves, may also result in placing them in the category of the predisposed.

To enumerate all the occasional causes would be to make a catalogue of casualties, which would be best done by copying from the accident columns of the daily press, and we shall merely refer to a few of a kind which may possess some special characters and notable features, not too obvious or common and familiar

Contusions of any kind, resulting from the causes stated, or even little abrasions from the simple misfit of a blanket kept in place by a surcingle too tightly buckled—anything, in fact, which may give rise either by its immediate effect or by its continuance,

to the slightest form of pathological change, may serve as a spark which may kindle into the most serious case of fistulous, diseased withers.

(*a*) *Excoriation.*—This is the simplest of the lesions of the skin covering the withers, or any portion of the body. It is most common in summer, when it appears in the form of a red spot, becoming rapidly covered with an abundant serous exudation, which rapidly forms a yellow or brownish crust, adherent to the underlying tissues. This is always painful, especially in summer, when it excites a violent pruritis, which may degenerate into a lesion of a serious nature.

Excoriations, however simple, ought never to be neglected, and precautions should always be taken against them. When they do occur, local healing applications, usually simple ones, are sufficient, and should be made without delay.

(*b*) *Warm Œdema.*—This is the result of the laceration of the subcutaneous cellular tissue and its subsequent inflammation. Saddle horses suffer from it, especially in summer and after long journeys. At such times, the skin becoming more or less adherent to the saddle, the motion of the animal, together with that of the skin, is communicated with every step to the subjacent cellular tissue (a sort of rubbing, to-and-fro motion); and this violence, though slight, produces by its long continuance the natural effect of inducing an inflammatory state in the tissue. This œdema is characterized by a tumefaction of the parts, warm and pitting under pressure, more or less painful, and having a tendency to spread toward dependent structures. It disappears by resorption in two or three days, but leaves a slight thickening of the cellular tissue, sometimes difficult to detect. This resorption takes place if the originating cause has, within a moderate period, ceased to operate; but if, on the contrary, it has been permitted to keep up its irritating action, the œdema will increase, and in due time the condition will be changed to that of suppuration,—a termination to be, if possible, by all means anticipated and prevented.

The removal of the cause, sometimes accomplished by merely giving the patient a season of rest, is the most important item in the treatment. The resorption of the œdema can be accelerated by means of massage, cold compresses, astringent lotions, weak stimulating frictions of an alcoholic nature, or cold irrigations.

(*c*) *Hematoma, or Bloody Tumor.*—This lesion is produced by a violent traumatism, such as a blow, a contusion, or a violent bite by some other animal. It develops immediately upon the occurrence of the cause, resulting from the laceration of the superficial blood vessels. It is characterized by a swelling, varying in size according to the nature of the producing cause. It is at first somewhat warm and fluctuating, then becoming puffy, and when the blood has coagulated, hard, tense and crepitating. Ordinarily it is not very warm or painful, but it becomes so after a few hours, and then there is danger of its assuming a suppurative character. Yet in other cases it may maintain that condition for two or three weeks, undergoing the process of resolution, the resorption usually becoming complete in that period. The correct diagnosis of this condition, and of any occurrent changes, some of which it is important to know, can be more satisfactorily established by exploration.

Left without interference and in the absence of irritating causes, the hematoma will usually subside by spontaneous action. In their treatment, cold applications are indicated during the first days of its existence, but at a later period, when the tumefaction has become of a denser consistency, absorbent and stimulating local medication is indicated, such as blisters of cantharides, or of mercurial preparations, or of the iodine compounds. These applications, however, must not be too hastily resorted to, lest the excessive or premature stimulation should end in the formation of abscesses. Except when there is positive evidence of suppuration, pressure by bandaging and the opening of the tumor with the bistoury are always contra-indicated.

(*d*) *Core, or Stickfast.* — This is caused by the immediate mortification of a portion of the skin, and often of the deeper tissues. It is a hairless scab of a blackish color, having the appearance of tanned leather. It is at times superficial, and has a tendency to extend to the subjacent structures. It is rigid and inflexible, and its pressure upon the deeper tissues tends to increase mortification. The tissues surrounding it are inflamed and their sensibility increased, and at a later period a process of elimination by suppuration takes place all around its edges. But this pus does not very readily escape, and there is always a portion remaining in the bottom of the sloughing surface which becomes fistulated with the formation of collections. If the core should

extend to the dorsal ligament or to the bones, the result will be necrosis and caries, and a true *diseased wither* will be the consequence. With these conditions, lymphangitis, leucophlegmasia, and deep abscesses may be expected, and usually supervene.

The sloughing of the mortified structure is always slow, especially when the deeper tissues are involved, but the wound which remains after the casting off of the core is not uniform in its subsequent action. When it is superficial it heals quite rapidly, but recovers only with great difficulty when it is deep-seated, and involves fibrous, cartilaginous and bony structures.

The prognosis of this lesion of the withers varies according to the thickness of the tissues which are involved; but it also varies according to its location, those which are situated on the lateral faces of the withers being less serious than those which occur on the median line.

The treatment indicated is strictly local. The first indication is to discontinue, or obviate, the irritating cause, by changing the harness, by *chambering* it, or, what is better, by refraining from working the animal until he has entirely recovered. The second indication is to hasten the sloughing of the mortified tissue, and allay the irritability which the animal betrays upon the slightest touch of the hand, or other object, upon his back. Topical remedies in the form of ointments, lotions or poultices, are indicated for this purpose. As soon as the process of sloughing begins it must be stimulated and encouraged. Warm compresses, antiseptic lotions, glycerine, phenial mixtures are then beneficial. The maintenance of simple moisture, by means of phenicated or creolined mixtures has, in our own experience, been of great advantage. If during the process of the elimination of the core the suppuration seems to be abundant with a tendency to accumulate instead of escaping, care must be taken to facilitate its removal by means of oakum, absorbing cotton, sponges or drainage tubes. Sometimes the core is of unusual size, with roots reaching deeply into the tissues beneath, but although this may be the case, *no attempt should ever be made to tear them forcibly away.* They must be permitted to drop away by spontaneous action. If the edges are very wide they may be trimmed off with the scissors or bistoury, but interference beyond this is never permissible. When they have entirely sloughed away there remains but a simple granulating wound, which ordinarily requires but mild forms of

treatment. The animal, however, ought not to be made to resume work until it is entirely healed.

(*e*) *Cyst, or Hygroma.*—These terms designate a tumor which usually forms on either the middle or the lateral face of the withers, originating in the dropsical condition of a serous bursa. On whatever part of the withers it may make its appearance, the originating cause is the same, and it is the effect of friction, or of the slight but long-continued irritation produced by an ill-fitting harness, inflicted while the animal is suffering from parasitic diseases. In these cases the connective areolæ of the bursa become the seat of an amount of secretion in excess of that which is removed by the act of resorption, and the accumulated hypersecreted fluid gathers into the cavity, to form the serous cyst.

When located in the median line, the hygroma constitutes a soft tumor, of varying size, from that of a pigeon's egg to that of a child's head—bilobulated, always soft, fluctuating, without heat, and painless; even transparent, when the skin is pigmentless. It always presents the differential characters of being well defined in its outlines, and without inflammatory peripherical infiltration.

When the cyst is on the side of the withers it may present some similar characters, but when it is deep, under the aponeurosis of the trapezium, or even under the rhomboideus, an exploration becomes necessary to establish the differential diagnosis from abscess, as upon the true nature of the tumor depends the immediate indications of treatment.

Hygroma of the withers may retain their characteristics for a long time, but many change in their nature under the influence of external irritations, bruises, contusions, improper treatment, etc. In that case the cyst is transformed into an abscess, or rather a suppurating cyst.

In respect to the treatment of cystic withers, the first indication is to remove the cause, and with this not only will the accumulation of the serosity cease, but the possibility of its transformation into the abscess form will be removed.

When the cyst is small and of recent formation, resolvent treatment is in order, as cantharides ointment, bichloride or biniodide of mercury pomatums, etc. Actual cauterization, in lines or in points, has given satisfactory results in chronic cases. Injections of tincture of iodine have also been recommended. Our

own experience warns us that it is not without danger, from its liability to be followed by a severe form of diseased withers. Bouley and Nocard, in relation to this mode of treatment, say "it is better to empty the cyst with a capilliary trocar, or by the aspirator, to wash its cavity with an antiseptic preparation, slightly irritating (5 per cent. solution of phenic acid), to repeat this injection several times, until the liquid taken out of the cyst is perfectly limpid, and then apply over the entire surface of the skin a thick coat of blister."

The purulent cyst is treated as an abscess.

(*f*) *Abscess.*—A phlegmon of the withers may rise suddenly under the influence of a severe traumatism, or become the sequel of a hematoma, or of a cyst. It appears most commonly on the superior part of the withers; sometimes on the sides, as a tumor more or less warm and painful, first uniformly hard and tense, and afterward soft, with a fluctuating center, and surrounded by an œdematous infiltration, more or less developed. If the abscess is superficial, ulceration of the skin soon takes place, followed by the escape of thick, white and creamy pus.

If, on the contrary (and this is often the case), the abscess is deep, developing itself under the the aponeurosis of the great dorsal, or of the rhomboideus muscle, or even deeper, under the cartilage of the scapula, or the thickness of the ilio-spinalis, the symptoms then, however, being less defined. The tumefaction is less characteristic, the heat less marked, the fluctuation not detectable, and the only sign which guides the surgeon is the excessive pain manifested upon the slightest pressure on the tumor, and from which the animal shrinks in fear. This soreness is in fact so great that in some animals it interferes with the action of the leg on the side affected. The appearance of general febrile symptoms is not uncommon at this period, with elevation of temperature, increase in the circulation, anorexia, excessive thirst, etc. At this period, also, it becomes important to be certain of the diagnosis, or at least to be sure of the existence of the suppuration, and its location must be accurately made out, in order to prevent the severe disorders that may be caused by the presence of the pus; a problem which can be only solved by repeated capillary exploring punctures, made at various points, and at given depths, according to the dimensions of the phlegmonous enlargement.

The prognosis of abscess of the withers depends altogether on

the seat it occupies. If superficial, and on the lateral faces of the region, it is not serious, If on the median line, it assumes a more severe character. If deep, it is also of a dangerous nature, unless it is simple or limited; but, on the contrary, if the quantity of the pus has continued to increase, and infiltration has taken place into the cellular tissue separating the muscular layers; or the suppuration has penetrated under the cartilage of the scapula; it will have assumed the most complicated form of the disease, with chances of recovery of a very doubtful character. When the presence of the pus has been detected, the immediate indication is to assist its discharge by a free incision down to the bottom of the cavity. The incision must be made on the most dependent part of the tumor; in such manner as to prevent the collection from settling in a cul-de-sac. A means of drainage must be provided, and the tube is preferred to the tent of oakum, or even to the seton, as more sure to reach all parts of the collection, and the more thoroughly to wash out the cavity.

If, however, the suppuration has not been detected, the application of local stimulation is indicated by means of warm compresses, hot poultices and the like; a constant watchfulness being maintained, meanwhile, in order to detect the presence of the pus at the earliest moment of its formation; when it must be immediately evacuated.

(*g*) *Wounds.*—Resulting from every variety of traumatic agencies, these injuries will necessarily vary in their extent and the nature of the tissues which are involved.

They therefore extend from the most trifling hurt of the skin to the severest lacerations of the important ligamentous, cartilaginous and bony structures contained in the region under consideration. With such a diversity in their form and nature there must also be a corresponding range in the character of the prognosis to be announced, from that of rapid spontaneous recovery, without interference, to the gravest of terminations.

One of the principal indications in the treatment of wounds of the withers is to prevent as much as possible the filtration and deposit of pus through the various layers of the region, and facilitate the cicatrization, by placing them in a state of immobility, and according to Bouley and Nocard, the best method of securing this suspension of movement is to apply a broad blister all around the wound, and to repeat the application after a few days. The

pain caused by this compels the animal to abstain from all movement, and besides this the inflammatory swelling resulting from the blister promotes the cicatrizing process by stimulating the proliferation of the cells of the repairing tissue. Aside from this special direction, the treatment of wounds of the withers involves no methods or indications different from those of similar hurts in other parts of the body. In most cases the surgeon must trust his experience and knowledge of general principles for guidance.

(*h*) "*Diseased Withers*" *proper: Fistulous Withers.*—As we have before stated, this denomination belongs to "a persisting lesion, fistulous in character, due to the mortification of the tissues of the withers, fibrous, yellow, cartilaginous or bony." It is necrotic in its nature, and while it may attack but one, it may also exist in all of these organs.

Whatever this condition may be, however, the necrosis is always manifested externally by an indicator, in the form of a fistula giving exit to an abundant, thin pus, serous, sanious, grayish in color, adhering to the hair, and irritating and excoriating the skin upon which it flows. At first it is odorless, and nearly homogeneous, but it soon becomes fœtid in odor and loaded with the detritus of necrotic tissues, more or less abundant, varying in thickness and in color, according to the nature of the tissue from which it is formed.

One or several of these fistulous openings may exist on one or both sides of the withers leading from the same or from different necrotic centers. Their number is not limited. Several of them may be in existence at the same time, especially when the disease has maintained its hold on the system for a period of three or four months without being checked or cured; a state of things not infrequently witnessed.

Their formation is explained by the constant accumulation of the pus in the sinuosities of the original tract, which by degrees overcomes the resistance of the surrounding structures, and establishes a channel for itself by the same process as that by which the first outlet was formed. It may sometimes happen that the opening of new canals becomes the cause of the closure, or perhaps only the constriction, of the original channel, and a new exploration becomes necessary to ascertain the new routes of the fluid. In this case their direction will be best made out by the injection of liquids through their open mouths.

The presence of one of these canals at the bottom of a wound may sometimes be detected by the appearance of large, fleshy, cone-shaped granulations, of a purplish color, from which an oozing of pus takes place upon the application of pressure.

But in another case, the orifice of the fistula may be directly on the skin, surrounded with granulations, protruding, soft and bleeding upon the slightest touch, with an escape of sanious pus between them; these granulations at a later period, flattening, as the wound contracts, until the thinned skin seems to be continuous with the smooth, reddish membrane which lines the internal face of the tract. It may even happen that a process of cicatrization taking place around the opening will transform its external outlet into a narrow strait which opens in the bottom of a cavity formed by the skin drawn inwardly by the cicatricial retraction of the indurated peri-fistulous tissue.

The direct exploration of the fistula is the best mode of ascertaining its existence, direction, extent and depth, and also the lesion which gives rise to it. This exploration ought to be made by the taxis, since it is obvious that no instrument can communicate an impression such as can be obtained by the touch of the finger. By the hand, therefore, must be ascertained the course and sinuosities of the fistula, its diverticulum, the nature of the necrosed tissue, and the extent of the mortification. But this manual exploration is not always possible, either because of the deficient caliber of the passage, or of its sinuosity, or its length. Resort must be had to the various probes and directors in use.

When the necrosis occupies the apex of one or more of the spinous processes, and the fistula is superficial, a slight incision will expose the diseased spot to ocular inspection, and the condition of things may be at once fully realized. When the lesion is limited to the cervical ligament, the eschar or slough will have an olive-greenish color, and will be of soft, pultaceous consistency, with a peculiar fœtid odor, from its maceration in the pus. If the necrosis has attacked the cartilages of the vertebræ, the mortified part assumes a yellow color, with a tint of pale green. In all cases, however, it is more or less loosened at its borders, and differs materially from that of the healthy tissue. And while at the point of separation it is covered with a layer of granulations, highly vascular, yet the continuity of the fibres between the healthy and the diseased tissues still exists in the parts which are

deeper and more central, where the connection is maintained by a sort of peduncle of varying size, through which the necrosis continues to be propagated. If the disease is of sufficiently long standing the necrosis may involve the entire thickness of the cartilage. In this case the spongy tissue of the vertebræ is exposed, covered with the healthy granulations, which contribute to the cicatrization. This, however, is a rare termination, the bone, ordinarily, becoming necrosed or carious, the necrosis being indicated by its brownish color, its dryness, its roughness and its sonority on percussion, while the caries is recognized by its friability, its red and yellowish color, the fœtid suppuration which oozes from its areola and the facility with which it yields to the edge of a sharp cutting instrument.

This condition of mortification may affect but a single vertebra, but it is not uncommon to find several, or possibly all, the spinous processes of the region affected.

While the fistula may be considered as the essential physical symptom of this ailment there are other symptoms coexisting. There is accompanying it an external swelling, sometimes diffuse, sometimes compact, and more or less indurated, according to the duration of its existence; very painful on pressure, and of which the form, direction and extent so perfectly correspond with those of the fistula, that it may be viewed as accurately representing the extent and limits of the lesion itself.

This induration increases in consistency, and may with time become infiltrated with calcareous deposits, or even bony growths, attached to the spinous processes.

The diagnostic and prognostical importance of this induration is very great. So long as there is no perceptible decrease in its dimensions, no apparent improvement in the external wound or modification in the nature and amount of the discharge can be of any favorable signification, and the surgeon may feel thoroughly assured that the disease continues unchanged in extent and character. As it diminishes it indicates that the necrosis is also contracting its limits, and it becomes certain that the sloughing has taken place and the wound is once again assuming its character of original simplicity. And when the swelling disappears, and the tissues have resumed their normal integrity, questions as to the depth of the fistula, or the extent of its sinuosities, and abundance of the discharge will cease to be of any significance.

In the beginning of the necrosis, while the parts are very sensitive, the exaggerated sensibility is not at all in proportion to the apparent extent of the disease. The animal shrinks from the manipulations of the touch, and this is a symptom which should be carefully considered in its relation to the progress of the disease, from the fact that in these manifestations it is passing through the same phases as those which marked the progress of the induration, running a sort of parallel with the duration of the necrosis, and diminishing as the sloughing proceeds, the interior situation being interpreted by the exterior phenomena, with some exceptions For there are cases in which it diminishes, while the disease continues without change, to exhibit the same severe symptoms. One effect of the abundant suppuration accompanying diseased withers, and the febrile symptoms which accompany it, is a rapid loss of flesh by the suffering animal.

The disease is always of long duration, and even when treated in the most rational manner. Its persistency will naturally correspond with the slow process of the sloughs and repairs of the tissues involved, themselves of comparatively low vitality and slow of change. But as soon as the separation of the diseased parts has taken place, however deep the wound may have been, or whatever the number and depth of the fistulæ, the cicatrization proceeds rapidly, and is completed in a comparatively short time. The terminations, which are to be looked for, are classified by Bouley and Nocard under the following heads:

1st. *Resolution.* — This is very rare if the disease has been neglected, and only occurs when it has been of a circumscribed extent and seated in a region favorably situated for the elimination of the mortified tissue, as when it escapes through large openings, without lying long enough in the midst of the muscular substance to produce the effects of the long confinement of the pus in the deeply situated regions.

2d. *Disease of the neck*, when the necrosis has spread as far forward as the cervical portion of the ligamentum nuchæ. This forms the more common termination, and is as serious and fatal as the original disease itself. It is too often met with, especially in low-bred animals of lymphatic constitution.

3d. *Death*, too frequently.

4th. *Putrid infection*, due to purulent fermentation and the absorption of septic principles.

5th. *Purulent infection*, *i. e.*, consecutive with the caries of the vertebræ and with the phlebitis of the veins of the region.

6th. *Purulent pleurisy*, resulting from the passage of the pus into the thoracic cavity through the intercostal muscles.

7th. *Exhaustion*, in consequence of the uncompensated loss of substance by the abundant continued suppuration, and its accompanying severe and persistent fever.

Fistulous withers is always a serious disease, not only because of its progressive tendency, but also because, however intelligent and proper may be the treatment it receives, it can never be relied on to prevent the spreading of the necrosis, and assure a healthy cicatrization. The degrees of severity nevertheless vary, according to circumstances. It is less serious when the necrosis is on the median line, and the prognosis is still more favorable when it is on the posterior part of the region. When situated forward it seems more tenacious, and the danger of its extending to the neck is greater. But it is principally when its seat is in the anterior part of the withers that the prognosis becomes alarming, as there the spinous processes are less prominent, the muscles thicker and more complicated in their arrangements, and the cartilage of the scapula nearer, all these being conditions which render the discharge of the pus more difficult and the purulent infiltrations more likely to take place, and where also counter-openings are made with more difficulty, and indeed become almost impossible if the purulent accumulations are situated on the inside of the scapula or its cartilage of prolongation.

It may be said, in fact, that the most important factor in the prognosis of this disease is the distance which separates the apex of the spinous processes of the vertebræ from the superior border of the cartilage of the scapula; the chances of recovery being in the ratio of the distance between those two points. It is thus that it becomes less grave in well-bred animals, with elevated projecting withers, than in low draught horses in which that region is depressed and thick, and the projection of the dorsal processes often replaced by a deep groove, bound on each side by the projection of the muscles and of the border of the scapular cartilage. The disease is also of less gravity in young animals, except when they are under the influence of distemper.

The treatment required in fistulous withers includes two principal indications: 1st. To facilitate the escape of the pus and

obviate its action upon the tissues with which it comes in contact and prevent its necrosing influence, and second to accelerate the elimination of the necrosed parts.

The first indication is fulfilled in enlarging the fistulas to the greatest extent possible. This is done with the straight bistoury carried in the groove of the director or of the S probe, introduced into the tract as far as possible. But when the fistula runs obliquely downward and inward, and has become complicated with diverticulums which run into the depths of the tissues, this enlargement of the fistula is more difficult, inasmuch as it necessitates too extensive a division of tissues for safety. This difficulty is obviated by establishing counter-openings at points corresponding with the bottom or cul-de-sac of the fistula.

The situation of these counter-openings must be carefully calculated in order to make the drainage perfect. The instruments most suitable are the dog seton needle, a curved trocar, or preferably the S probe, and a straight bistoury. The openings must be liberal to assure the best results, and they must be prevented from contracting or too rapidly closing, and so checking the purulent flow either by the introduction of a tent of oakum or other permeable foreign substance, or, and it is much the better method, by the use of a drainage tube similar to the India rubber irrigation tube. This implement, besides fulfilling all the other indications desired, possesses the additional advantage of facilitating the injection of fluid detergents or curatives into the fistulous tract. When the drainage has become well established irrigations must be made two or three times daily as long as may be necessary. The fluids best adapted as being both detergent and curative in their nature are pure tepid water, phenicated water (five per cent. solution), or permanganate of potash solution (one to two per cent.), or again simple alcoholic water. The irrigation can be made with an ordinary syringe. Peuch and Toussaint, however, say "that when the circumstances allow it cold water in continued irrigation constitutes the best medication and that which prevents most certainly all complications. On that account they cannot recommend it too strongly."

While this form of treatment is usually successful in cases of lesser severity, there are many instances in which they become powerless, and other means become necessary for the removal of the necrosed part. In times gone by caustics, in both the solid

and liquid form, were held in high repute, even in the form of actual cauterization, as recommended by Lafosse. In later times, however, the serious effects which followed their application caused them to be ignored. Preparations of lesser severity were then recommended, among which were Villate's solution; those of the sulphates of copper or of zinc, in various degrees of strength; of tincture of iodine, of spirits of turpentine, of nitrate of silver, and even of tartar emetic, and their use was followed by good results.

Cantharides ointment, applied externally over the swelling, and by injections into the fistulous tract, after being diluted with tincture of cantharides, is also recommended.

When the pus has filtrated inside of the shoulder, Bouley and Nocard suggest the propriety of "attempting to lacerate with a metallic rod the cellular tissue of the internal face of the shoulder, so as to produce an abscess by congestion, whose opening, which must be made wide, would allow the escape of the pus, and the possible frequent cleansing of the enormous fistula thus formed. By this process one might avoid the serious accidents likely to result from the sejourn of the pus, and its fermentation from the contact of the tissues."

For cases like these Lafosse recommended the trephining of the scapula—a very serious operation. It is said to have been successful with him, but it must be a difficult matter to perform it properly in such a manner that the trephine is applied at a point on the surface exactly corresponding to the bottom of the fistula.

When all means of so stimulating the action of the parts as to effect the arrest of the necrosis, and the sloughing of the mortified structure have failed, there is but one alternative left, and that is the direct amputation of the apex of the spinous process, and the excision of the diseased portion of the ligament. But this operation, indicated by Lafosse, is possible only when the disease is limited to the apex of the most prominent spinous processes. It is positively contra indicated in low and thick withers, in which the wound left after the operation would be a hollow, cup-shaped depression, from which the pus would naturally gravitate and filtrate in all directions.

The instruments necessary for this operation are: A grooved director, curved and straight bistouries, sage-knives, sharp draw-

ing knives, bull-dog forceps, and an amputating saw; and with these the appliances usually needed in the way of hemostatics, and the necessary dressings, artery forceps, oakum, sponges, drainer-tubes, dog seton needles, etc. The various steps of the operation are thus described by Peuch and Toussaint:

"Everything being ready, the operator enlarges the fistulous tract, simple or ramified as it may be, so as to expose the necrosis. In making this special attention must be taken to give the incision a direction favorable to the escape of the pus. This first step of the operation is accompanied with abundant hemorrhage, which must first of all be arrested either by ligating the divided blood vessels, or by plugging the wound with oakum moistened with a solution of perchloride of iron. The hemorrhage stopped, and the necrosis exposed, the *second step*, and the important one of the operation, is proceeded with. To effect this the necrosed surface is limited by a double incision, made with a sharp instrument, straight bistoury, or sage-knife. This incision involves the entire thickness of the cervical ligament and the fibro-cartilage covering the apex of the spinous process and passing under this cartilage. In making this incision the operator must be careful not to injure any of the other processes if they are not diseased. This done, with the sage-knife the deepest layers of the cartilage are excised, and then, with the drawing knife, the bony tissue underneath is resected so as not to leave the smallest particle of necrosed tissue. Here, as in some cases of foot operation, not only must all the diseased tissue be removed, but some of the healthy structures. The resection of the apex of the necrosed processes can be made with the saw instead of the drawing knife. But this instrument is preferable, as it is easier to manipulate and it always leaves a smooth wound."

The subsequent treatment is of the routine kind. The parts are, of course, thoroughly cleansed; the hemorrhage is controlled by pressure, a drain tube is secured at the lower angle of the wound, and the edges are brought together by quilled sutures. Repeated injections of phenicated water are passed through the drainage tubes, and the patient is watched in order to prevent him from injuring himself by rubbing. If the season and the circumstances permit, continued irrigation is established.

Toward the fourth or fifth day the sutures are removed and the dressing changed. The granulating process is carefully

watched, and its progress kept under control by mild caustic applications, or by pressure, to prevent an uneven and too rapid cicatrization

During the treatment the animal must be kept quiet, and even in some cases it will be prudent to hobble his fore legs in order to limit his movements and prevent the filtration of the pus under the shoulder. He is to be kept on light and nutritive diet, to compensate for the losses resulting from the abundant suppuration, and when the disease has disappeared, and there is only a superficial wound remaining, and no more fear of returning complications or relapses, the animal can be returned to his labors, but must make his adieus to the bulky collar which has weighed so heavily on his neck, and substitute for it the equally efficient and far more sightly Dutch collar, which has never yet in any way contributed to bring upon its wearer the calamity of diseased withers.

DISEASES OF THE POLL.

This region of the neck is the seat of lesions, frequently occurring, and of varying nature. They include excoriations, œdematous swellings, cores, cysts, bloody tumors, abscesses, bruises, wounds, etc., any of which may become complicated, and terminate in *poll evil*, or the necrosis of one of the fibrous, elastic, or bony elements which enter into the composition of that region.

In considering the anatomical structure of the portion of the neck in question we find on the *top* a mass of hair, separated from that of the superior border of the neck by a surface which has become callous by the constant frictions of the head-strap of the halter or of the bridle; the *skin* (Fig. 563), thick on the median line, thinner on the sides, but always loosely connected with the subjacent tissues; a thick layer of *connective* tissue, more or less infiltrated with fat, and lardaceous in low-bred horses; the *cord* of the ligamentum nuchæ, which is attached to the occipital bone, and more or less covered by the cervico-auricularis muscles; on each side, and on the same level, the terminal insertion of the *splenius* muscles, and forming an elevation which is covered by the aponeurosis common to that muscle and the small complexus, which itself makes an apparatus of retention of great resistance to the organs of the region; then another layer, composed of the large tendon of the *great complexus*, the *small oblique* muscle of

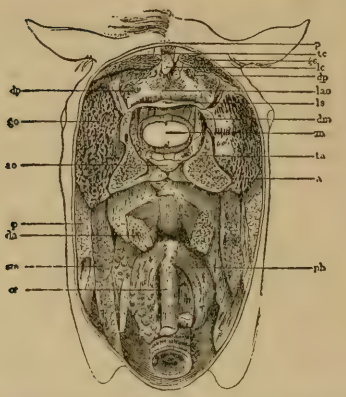


FIG. 563.—Section of the Neck on a Level with the Poll.

p.—The skin. tc.—Lardaceous connective tissue on the top of cervical ligament. gc.—Superior extremity of the great complexus and small oblique muscle of the head. lc.—Ligament nuchæ. dp.—Posterior straight muscles of the head. lao.—Atloido-occipital ligament. ls.—Superior part of the atlas. sm.—Rachidian dura mater. m.—Spinal marrow. ta.—Adipose tissue of the rachidian canal. a.—Atlas. ph.—Pharynx. go.—Section of the great oblique muscle of the head. ao.—Section of odontoid process of the axis. p.—Parotid gland. sm.—Sub-maxillary gland. da.—Anterior straight of the head. œ.—Œsophagus.

the head, the *great oblique*, and under them, the *posterior straight* muscles of the head; a serous sac, assisting the gliding of the cord of the ligamentum nuchæ over the atlas, which is very small in young animals, assumes larges dimensions in old subjects; and, finally, a skeleton of the region, the atlas, the axis and the occipito-atloid and atloido-axoid articulations. Two large arteries are distributed throughout the locality, the *occipito-muscular* and the *atloido-muscular*.

The causes in which diseases of the poll originate are numerous. Among them may be mentioned first, bruises, from blows given with the handle of a whip, or of a fork; contusions and continued frictions against hard substances, as the manger; the pressure and rubbing of the parts of the harness (the bridle, etc.), which pass over that region; the repeated rubbing which the animal inflicts upon himself when he is affected with parasitic cutaneous disease; the blows which he receives when in tossing his head, he brings it in contact with the ceiling of his stable, when this is too low, and he has formed the habit of pulling back on the halter; the spreading of diseases of the neck by the extension of the necrosis of the cord of the cervical ligament, all these are

considered to be so many active agencies in the etiology of poll evil.

In cattle it is most commonly chargeable to the pressure and frictions of the yoke. Hertwig, with other German authors, considers it, and particularly the sus-atloid hygroma, as the local manifestation of a diathesic condition, such as rheumatism and distemper. They also admit that the true poll evil may develop itself spontaneously, and independently of all other traumatic causes.

In considering the various forms which the disease may assume in this locality we shall adopt the division sanctioned by Bouley, who has thus arranged them.

A—Excoriations; B—Œdematous Swellings; C—Core; D—Bloody Tumors.

Diseases of the poll, in horses, exhibit too close a resemblance in their type and general history to escape notice, and the therapeutic indications exhibited in them are the same. And it must be borne in mind that however slight they may appear to be, and whatever may be their nature, they always require immediate attention and careful watching, and in all cases the use of the bridle and the halter must be suspended.

E.—Cyst.

Cysts of the poll are divided into *superficial* and *deep*. The former, which are of uncommon occurrence, have their seat in the subcutaneous cellular tissue, and possess features in common with those which appear at the withers. The latter is an abnormal dilatation of the serous sac which facilitates the gliding of the cervical cord upon the atlas; it is also known as the *atloid hygroma*. It generally begins suddenly, and is manifested by the presence of a soft tumor, fluctuating, spherical, or bilobulated by the median pressure of the cervical ligament. It is usually painless, except when it is the result of acute violence, in which case it may be accompanied with inflammatory symptoms, which may extend to suppuration, but in such cases, which, however, are infrequent, there is also a degree of fever corresponding in intensity with the other features of the case. The fluctuation is at first uniform, and easily detected, but at a later period, as the secretion becomes more abundant, and the tension of the pouch be-

comes greater, and the thickening of the walls progresses, it becomes obscure.

In the stable the animal is very quiet, standing with the neck extended and the head carried downward; he moves with difficulty, without raising the head, and avoiding all movements of the muscles of the neck, and especially of the extensors. At times the distension of the walls of the cyst may be so extreme that the capsular ligament of the occipito-atloid joint is pushed inward in the rachidian canal, and when this occurs nervous symptoms appear, caused by the pressure of the rachidian bulbs.

If unremedied, it assumes a chronic condition, with progressive distension, which may end in death by pressure upon the bulb. Purulent transformation, and poll evil proper, are also the possible terminations of the atloid hygroma; indeed, it is only in rare instances that it is known to subside by resolution or resorption. In cases of doubtful diagnosis as to the formation of cystic or purulent collections, exploration will relieve the doubt, and at once settle the question of treatment.

Blistering and absorbing applications, often repeated, and combined with aspiration, have often relieved the atloid hygroma. Cauterization in lines or points, both superficial and deep, are also recommended. Injections of tincture of iodine have also their supporters, but they are sometimes liable to give rise to violent irritation, ending in purulent collections, and perhaps necrosis possibly of the cervical ligament.

F.—Abscess.

This is the most frequent lesion of the poll, forming at once, when the exciting cause is sufficiently active, or when originating in the manner already described.

It consists at first, of a diffused, not well defined, swelling of the abundant cellular tissue which separates the muscles of the region, to coalesce at a later period, to form a single purulent gathering, but not until it has macerated and destroyed all the intermediate tissues into which it had become infiltrated, and this destructive process advances so actively and persistently that when it reaches the surface, instead of closing up, the abscess has become transformed into a fistulous center, with a constant discharge of mortified, fibrous, elastic, or bony structure.

The establishment of the suppurative process, even before any local symptoms have been manifested, is betrayed by the changed appearance of the animal. As described in the previous pages, he becomes listless and dull, standing quietly with the neck extended and the head resting on the manger; refusing to move, or if doing so, never raising his head, and by grunts and moans betraying the great pain he is suffering. If his head be raised by force he rebels against it, struggles, goes backward, strikes with his fore feet, and perhaps rears.

By bringing the animal under control and restraint, as by throwing him, the abscess may be easily discovered, on one side of the neck, as a diffused swelling, tense, warm, and so excessively sensitive to the slightest contact, that it is with the greatest difficulty that an obscure and deep fluctuation can be detected. The positive nature of this tumor must then be made out as early as possible, by repeated capillary explorations, since if discovered to be unmistakably of a suppurative nature, a free exit to the pus must be at once established, to avoid its necrotic tendency; while if it be a cyst, there is danger in opening it, arising from its liability to be followed by necrosis of the cervical ligament.

The prognosis of this abscess will vary according to the length of time which may have elapsed between its inception and its detection. The serious nature of this prognosis is explained by the fact of the incompressibility of the pus and the inextensibility of the aponeurosis of the splenius and complexus muscles, which resist the swelling of the inflamed tissues, and by their compression and strangulation, become the cause of gangrene. If a diagnosis of abscess is made, and it is immediately opened, the cavity may assume the character of an ordinary abscess, and close entirely; but this is a rare termination. More ordinarily, the incarceration of the infiltrated pus between the muscular layers is an obstacle to its free and complete discharge, and it remains infiltrated, gathering into cul-de-sacs, and migrating irregularly between the muscles. Hence the formation of so many fistulous tracts, opening at diverse points on the skin, which are generally the result of the necrosis of the ligamentum nuchæ, or of the fibrous tissue of the tendons, or even of that of the atlas, or possibly of the occipital bone.

All the dangers which are likely to follow the existence of an abscess at the poll, demonstrate the necessity for prompt surgi-

cal interference. Whenever the presence of the pus is established the abscess must be opened, and opened very freely. This must be carefully done. The puncture must be made in the center of the tumor, and after the evacuation of the pus it must be extended with the bistoury, introduced with the aid of a grooved director, and making, of course, a counter-opening at the most dependent point. This incision should be made parallel with the cervical ligament, and must be carefully made, in order to avoid wounding the capsular ligament of the joint, or the occipito-muscular artery.

The hemorrhage which accompanies this operation is easily controlled by pressure. Antiseptic dressings, with the use of a drainage tube constitute the after-treatment, which must be similar to that of the same diseases at the neck and at the withers, with the difference, perhaps, that the dressings and cleanings must be oftener renewed.

If no complications arise the wound will heal without difficulty, and the animal may be able to resume work after two or three weeks' recuperation.

Poll Evil.

But if, on the contrary, the animal is suffering with the persistent and tenacious lesion which consists in the necrosis of the yellow or white fibrous tissue of the region, or a diseased condition of the surrounding bones, we are confronted with the very serious affection commonly known as poll evil.

This disease originates, ordinarily, in one of those already considered, and yet it may appear spontaneously, if the instigating traumatism from which it grew has been sufficiently severe or violent. And, again, it may be a sequelæ or extension of a similar diseased process in the neck.

Its characteristic appearance is that of a large induration, developed around one or several fistulous tracts, from which escapes a thin, sanious pus, of fœtid odor. Upon being explored these fistulas are found to vary in their direction, in their depth, and in the tissue on which they terminate. Exploring with the probe, or, more certain, with the finger, a cavity is found more or less filled with pus, with granulating walls, in the bottom of which the cervical ligament is felt, isolated, roughened and more or less escharrified, or, if this chord has remained intact, it will indicate

that the seat of the lesions is the tendon common of the splenius, or of the complexus, or, perhaps, of the oblique or posterior straight muscles.

At an advanced period, when the progress of the mortification has been for some time unchecked, and the bony insertions of the ligament, or of the tendons, have become affected, the surfaces of these bones also become affected and their roughened or possibly necrotic character is readily recognized by the exploring finger.

It may also happen that the capsular ligament of the joint, constantly macerated in the pus, softens and yields, and the penetration of the discharge into the vertebral canal soon ends the case by the rapid development of suppurative cerebro-spinal meningitis.

Hertwig and Lafosse have reported instances where anchylosis of the occipito-atloid joint had taken place.

There is in the museum of the American Veterinary College a preparation of an anchylosis of the occipito-atloid articulation which undoubtedly is the result of a case of chronic poll evil.

The prognosis of this ailment is always serious. A slight lesion may grow and develop into a case, with all its dangers. For this reason a cautious expression of opinion on the part of the surgeon is equally due to considerations of policy as to the obligations of truth.

The treatment is essentially and exclusively surgical.

In the simplest cases free openings and ample drainage of the wound, with plenty of washing and antiseptic attention will control the trouble.

In more severe cases, where the presence of the fistulous tracts is stimulated by the induration of the parts, and the constant movements of their walls, the external application of a strong blister and the injection into the fistulæ of tincture of iodine, or of cantharides, or of solutions, more or less concentrated, of tartar emetic, nitrate of silver, chloride of zinc, etc., will contribute to immobilize the parts and stimulate the granulating and healing process.

The section of the cord of the ligamentum nuchæ is indicated when the tension of the region becomes too rigid, and the pain inordinate. This alleviating measure was first instituted by Langenbacher and Hertwig in Germany; then by Lafosse and Rey in France, and it has always given excellent results. It relieves the

pressure and the pain, obviates the danger of gangrene, facilitates the examination of the wound, and greatly aids the excision of the soft, necrosed tissues, and the scraping of their bony attachments.

The operation is simple. The patient is thrown, and a straight bistoury, or in preference, a blunt curved tenotomy knife are the instruments. With the latter, the division of the skin is avoided. The ligamentous section is subcutaneous, the instrument being introduced under the cord, and the division made from within outward. When the section is made, the ends of the ligament draw apart. If it is necrosed, the anterior stump is removed down to its insertion in the occipital bone, which may also be scraped. The same treatment is applied to the tendons of the muscles. In fact, the opening is cleared from all mortified substances, and treated as a simple wound.

After the operation, the animal carries his head low down and vertical, but when the wound becomes cicatrized, and continuity is re-established between the stump of the ligament and the cervical tuberosity, the head becomes by degrees elevated, and is eventually restored to its normal position and natural liberty of motion.

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